

Solvay Specialty Polymers USA, LLC.,  
10 Leonard Lane  
West Deptford, New Jersey 08096

RE: Perfluorinated Compounds (PFCs) Work Plan

NJDEP and USEPA-RCRA, along with contributions from other groups (Delaware River Basin Commission, Delaware Riverkeeper Network, USEPA National Exposure Research Laboratories) have reviewed the Perfluorinated Compounds (PFCs) Work Plan submitted on November 15, 2013 to investigate the occurrence of PFC contamination in drinking water and the environment and offer the following comments:

#### **General Comments**

- ✓ 1. It is suggested that data on PFC concentrations in water be given in ng/L instead of µg/L. This is the current convention in papers and reports presenting these data, and the data are more easily understandable in these units.
2. The term "Municipal Utility Authority (MUA)" is used throughout to refer to public community water supplies (PWS). This term is often used to refer to wastewater treatment plants (publicly owned treatment works) such as Gloucester County MUA and Camden County MUA, as well as municipally owned public water systems. It is suggested that the term "public community water systems" or "PWS" be used instead. It should be noted that, although the 7 public community water supplies for which sampling is proposed are all "municipal" (e.g. publicly owned), this is not necessarily the case for all public community water supplies in the vicinity. Many public community water supplies are privately owned – for example, the NJ American Ranney Station and Logan-Birch Creek facilities ("PWS A" and "PWS B" in Post et al., 2013).
3. Main Text and Appendix B: The Field Sampling Plan (FSP) in Appendix B should have been merged and presented with the main text. It is confusing and made the review more difficult than it had to be to have the work plan information placed in two separate areas in the document. Where there is overlap between the two, comments may apply to both the main text and the FSP.

#### **Section 1 - Project Background**

- ✓ 1. DEP and USEPA provide oversight of Solvay remediation additionally under RCRA 2020 Corrective Action Program.
- ⇒ 2. The objectives of the effort described in the Work Plan are not well described and should be more clearly defined. For example, the objective could be "to evaluate the geographic and temporal extent of environmental occurrence of perfluorinated compounds related to their use at the Solvay Specialty Polymers site" or "to conduct a preliminary investigation of environmental occurrence and dispersion of PFCs related to their use at the Solvay Specialty Polymers site in order to gather information that will guide decisions about further characterization of the site in the future" or some other clearly stated objective.

- ✓ 3. Additionally, the reasons that the presence of perfluorinated compounds may be present in the environment and are of potential concern in this vicinity should be stated. Solvay has provided data on historic annual releases of PFCs to air and water from this site in a separate table. The fact that these releases occurred over a period of about 25 years (1985-2010) should be mentioned. Potential routes of human exposures should also be briefly mentioned. For example, occurrence in public water supplies may lead to human exposure through drinking water; the Delaware River is not used as a drinking water source in this location but PFCs could be taken up into fish (of potential concern due to fish consumption and/or ecological effects), etc.
- ✓ 4. The sampling and modeling proposed by Solvay are not sufficient to fully characterize the fate and occurrence of PFCs discharged from the site. No justification is given for how the 7 PWS for which sampling is proposed were chosen. Comparison of the locations of public community water supply wells proposed to be tested (shown on the map in Figure 2 of the work plan) with the map of drinking water wells near the site developed by the NJDEP GIS group reveals that there are a number of additional public community water supply wells very close to those proposed to be tested that are not included. Additionally, the available data indicates that PFNA from the site has likely reached public community water supplies more distant from the site than the area in which sampling is proposed. Importantly, there are private wells and several public non-community wells in this locality. These wells are at least as vulnerable to PFC contamination as the public water system wells (PWS) and should be sampled.
- 5 4. Historical information on the treatment of wastewater from processes that used PFCs at the site should be provided, including the fate of the sludge from treatment of this wastewater. At the September 2013 meeting with NJDEP and USEPA, Solvay said that the wastewater containing organic contaminants is currently treated by Gloucester County MUA. Was the organic wastewater from the site sent to Gloucester County MUA for the entire period since 1985? See comment #8.

#### Section 1.2: Historical Operations and Activities at the Site:

- ✓ 5. As above, information on the annual amounts of perfluorinated compounds used and discharged at the site was provided by Solvay in a separate table. This table should be included in the work plan and referenced in this section, since it provides important information on historical operations at the site. Additionally, historical information on the fate of wastewater and the sludge from the treated wastewater, as well as any off-site disposal in landfills should be discussed here.
- ✓ 6. Include any soils remediation conducted by Solvay or its predecessors that included on-site disposal of soils.
- ✓ 7. Please indicate whether sources that created the organic chlorinated contamination would also have had PFC compounds, which may have led to similar migration pathways.
8. Include any information known on the origination of dredge spoils that are now located on the northern area of the site. If the material was dredged in the manufacturing period of the facility, it is a potential PFC source. If the dredge material remains a possible release source then it should be addressed in the work plan. The dredge material needs to be evaluated as a source to the shallow ground water both pre and post cap. If releases occur to the shallow ground water within or beneath the dredge material further PFC migration either to river discharge and infiltration into the PRM Aquifer may have or may be occurring.

9. The description and composition of Surflon is unclear and should be clarified. The term "telomer-based fluorosurfactant" used to describe Surflon is confusing to the reader. Is this term used because the perfluorinated carboxylates in Surflon were made by the telomerization process (as opposed to other processes for manufacture of PFCs), or because fluorinated telomers are also present in the mixture? According to Prevedouros et al. (2006), Surflon S-111 is "a commercial product (CAS 72968-3-88), [that] is described as 'Fatty acids, C7-13, perfluoro, ammonium salts' a mixture of PFCAs between seven and thirteen carbons in length" containing 0.78% PFOA (C8), 74% PFNA (C9), 0.37 % PFDA (C10), 20% PFUnDA (C11), and 0.1% PFDD (C12), and 5% PFTD (C13). It should be stated that Surflon is a mixture of long chain perfluorinated carboxylates, and the percentage (or range of percentages) of each compound in the mixture should be provided. It would be helpful to include the CAS numbers and structures of these compounds.

#### Section 1.3.2 - Municipal Utility Authority Occurrence Studies:

10. The statement that PFOA concentrations of > 40 ng/L were found in at least one sample from 12% of PWS in the 2006 NJDEP study (NJDEP, 2007; Post et al., 2009) is not accurate. None of the samples in the 2006 NJDEP study exceeded 40 ng/L for PFOA. PFOA at  $\geq 40$  ng/L was found in subsequent follow-up samples from some of these PWS at the same or different points of entry tested in the 2006 NJDEP study. Also, PFOA at  $\geq 40$  ng/L was found in two of the 31 PWS tested by NJDEP in 2009, as well as in some PWS not included in either study that submitted monitoring data to NJDEP.

11. Of the three PWS with PFNA at  $\geq 40$  ng/L reported in Post et al. (2013), two were included in the 2009 NJDEP study (Paulsboro Water Dept. and Southeast Morris County MUA) and the third (NJ American Logan-Birch Creek) was one of the two additional PWS reporting ongoing monitoring data on the same 10 PFCs to NJDEP.

#### Section 2 - Proposed Workplan

##### Section 2.1 - Objectives:

1. The overall objective for the proposed project is not clearly stated, but the proposed work plan appears to be an initial screening effort rather than a complete characterization. The overall objective should be clearly stated. For example, "to characterize the geographic extent and magnitude of the occurrence of PFCs in environmental media in the vicinity of the Solvay site," or "to conduct initial sampling of the occurrence of PFCs in environmental media in the vicinity of the Solvay site to aid in decision-making for future sampling and modeling," or something else if appropriate.

If the intent is to conduct an initial screening, it should be clearly stated how the results of this initial sampling will be used to determine what, if any, additional sampling will be conducted to fully characterize the extent of PFC occurrence in environmental media in this locality.

2. The analytical methods that will be used are certified to analyze a broader suite of PFCs than C8 to C13. It is recommended that data for all PFCs for which these methods are certified by NJDEP be reported.

3. Text in the second paragraph states: "The air modeling results are expected to describe the potential extent and geographical distribution of historical deposition patterns." Dr. Alex Polissar, Office of Science air modeler, has reviewed the air modeling proposed in Appendix C. Although he is not familiar with the specific details of the AERMOD, the proposed plan looks reasonable to him. However, large

uncertainties related to different factors, such as sources of PFNA and other PFCs and their emission rates, meteorology, particle size distribution assumptions, dispersion modeling itself, etc., will produce air modeling results with large uncertainties. It will be difficult to draw any firm conclusions on the geographical extent and magnitude of contamination of the area by using the results of the air modeling alone. Dr. Andrew Lindstrom, USEPA National Exposure Research Laboratories, emphasizes that soil sampling can provide important information to support and validate the predictions of the air modeling. The available data from PWS in Gloucester County (discussed above) suggests that the geographical distribution of PFNA from the Solvay site is much more widespread than the area in which sampling has been proposed. Therefore, the available environmental monitoring data (groundwater, soil etc.) should be used along with the air modeling results to characterize the extent of PFC occurrence in this locality. See also citations in Section 2.2. below.

4. Again, as above, the overall purpose of describing the potential extent and geographical distribution of historical deposition patterns should be described. Specifically, if further sampling is planned in areas where historical deposition may have occurred not included in this work plan, it should be so stated. The work plan does not fully address potential historic runoff from the manufacturing facility area. On-site soils are not being sampled until, possibly, after the completion of the air dispersion and deposition model. Please describe any potential sources of spills and soil remediation areas that could produce contaminated runoff. These data gaps in soil concentration and runoff potential should be addressed with the results of the air dispersion and deposition model.
5. As previously discussed, Greg John from the DEP Air Program will also review and comment on the proposed air modeling. Receipt of additional information regarding input files from Solvay is pending. Please forward this information as soon as available so a full review can be conducted.

#### Section 2.2 – Data Quality Objectives:

6. The overall project objective should be stated. The planned sampling and air modeling listed here would provide a preliminary screening assessment, but not a full characterization of the extent of PFNA occurrence in this locality.
7. As above, sampling of the seven PWS mentioned in the Work Plan is not sufficient to characterize the extent of groundwater contamination and potential human exposure through drinking water. Additional public community water supplies, as wells as public non-community water supplies and private wells should be sampled. A DQO should be added to assess PFC concentrations in the municipal water supplies (and the on-site wells?) against the NJDEP preliminary health-based guidance value of 0.04 µg/L for PFOA as cited in Section 1.3.2.
8. The DQOs for the surface water and sediment sampling seem to be incomplete. Based on the locations mentioned in Section 2.3.3, it seems that one of the main objectives is to confirm the previous data collected in the Delaware River, as the previous DRBC locations will be sampled. If this is the case, then inclusion of all PFCs analyzed in those investigations is recommended. In addition, a detection limit equivalent to the DRBC 2007, 2008 and 2009 studies at 1 to 2 ng/L for PFC in surface water should be achieved in the proposed work. If Solvay is unable or unwilling to expand the list of PFC analytes, the DRBC recommends split samples for the Delaware River surface water samples to be submitted to Test America for the 7 PFC proposed in the work plan and to Axys Analytical, the original laboratory used in the 2007 to 2009 surveys. The new surface water samples would be analyzed for 13 PFC, 3 fluorotelemer sulfonates and 10 phosphorus based per/poly fluoroalkyl substances at Axys Analytical. The DRBC is

able to support this effort with available monitoring funds at a level not to exceed \$31,000. Additional discussion will be needed to coordinate the split samples.

9. In conjunction with air modeling to determine the potential extent of aerial distribution of PFCs, the potential for PFCs migration to groundwater after deposition from air onto soil could be evaluated using approaches previously developed by others. See the following two papers:

Paustenbach DJ, Panko JM, Scott PK, Unice KM. 2007/ A methodology for estimating human exposure to perfluorooctanoic acid (PFOA): a retrospective exposure assessment of a community (1951-2003). *J Toxicol Environ Health A*. 70(1):28-57.

Shin HM, Vieira VM, Ryan PB, Detwiler R, Sanders B, Steenland K, Bartell SM. 2011. Environmental fate and transport modeling for perfluorooctanoic acid emitted from the Washington Works Facility in West Virginia. *Environ Sci Technol*. 45(4):1435-42.

\* 10. It is stated on page 2-2 that the Data Quality Objectives are consistent with "Guidance on Systematic Planning Using the Data Quality Objectives Process (USEPA, 2006). This document is found at: <http://www.epa.gov/quality/qs-docs/g4-final.pdf>. Although the names of the steps in the Table 3 of the Work Plan are similar to (but not identical) to the names of the steps in the USEPA Data Quality Objectives Process (Figure 2, p. 8 of USEPA (2006), the descriptions of the steps in the Work Plan are not consistent with USEPA (2006). If USEPA (2006) is to be cited as the model for the Data Quality Objectives, Table 3 should be revised to be consistent with the process provided by USEPA (2006). Particularly, the major outputs for each step, and the examples for each step, provided in USEPA (2006) should be used as a guide. See below:

1. *State the Problem.* The overall problem is not stated clearly stated, is not sufficiently broad, and is not presented in enough detail, based on the process and examples provided in USEPA (2006).

2. *Identify the Decision.* This step is called "Identify Goals of the Study" in USEPA (2006). The description of this step in Table 3 does not include the principal outputs for this step described by USEPA (2006), particularly a list of alternative outcomes or actions or a decision statement. See principal outputs and examples in USEPA (2006).

3. *Identify Inputs to the Decision.* This step is called "Identify Information Inputs" by USEPA (2006). According to the process provided in USEPA (2006), this step should include more than simply the analytical methods and QAPP. See principal outputs and examples in USEPA (2006).

4. *Define the Boundaries.* The rationale for determining the boundaries of the investigation is not provided here or elsewhere. "Nearby" MUA facilities is a vague statement with no rationale provided. As discussed above, it is not clear why offsite monitoring wells are not included, available data indicates the need to sample additional public community water systems than those included in the draft Work Plan, private wells and public non-community water supplies. Soil sampling would also be useful in evaluating the extent of contamination.

5. *Develop a Decision Rule.* This step is called "Develop the Analytic Approach" by USEPA (2006). Based on the process and examples provided in USEPA (2006), the description of this step should be broader than as written in the draft Work Plan.

It is stated that no additional work will be performed if the PACSRC results are satisfactory and the sampling results meet the project objectives. The actions that will be taken if the results are not satisfactory or do not meet the project objectives should be provided.

6. *Specify Limits on Decision Errors.* This step is called "Specify Performance or Acceptance Criteria" by USEPA (2006).

7. *Optimize the Design for Obtaining Data.* This step is called "Develop the Detailed Plan for Obtaining Data" by USEPA (2006). According the process and examples provided by USEPA (2006), more detail should be provided on the work plan than is provided here.

#### Section 2.3.1: MUA Sampling

11. As above, change terminology to PWS sampling.

12. Inactive Paulsboro municipal wells 4 and 5 should be sampled, if they have not already been sealed.

13. The rationale for limiting sampling to these seven PWS is unclear. It should be clarified that, while NJDEP provided information on the locations of PWS in the vicinity of the Solvay site, NJDEP did not recommend that sampling be limited to these PWS. As discussed above, available information indicates that PFNA has reached additional PWS more distant than the seven mentioned here, and that sampling of PWS over a larger area should be conducted. Additionally, public non-community water supplies and private wells in the same geographic area should be sampled. Please include a plan to sample additional community and non-community PWS wells and private drinking water wells for PFCs in an iterative manner (stepping out to sample additional wells when contamination is found).

#### Section 2.3.2 - Groundwater sampling

14. There are multiple complexities within the Potomac-Raritan-Magothy (PRM) aquifer in the region, including multiple aquifer zones, multiple confining zones, the induced infiltration from the Delaware River, and shifting Public Supply well production. At a minimum, a ground water flow and transport model may be required to understand the PFC distribution once the first sets of data has been collected.

15. The inclusion of MW-1D is recommended; for a total of 32 wells due to historically elevated levels of contaminants in this well. Among other areas, it is stated that wells were selected "...within the axes..." Please clarify.

16. Please indicate that additional groundwater sampling extending offsite will be conducted in an iterative manner to determine the extent of groundwater contamination by PFCs.

#### Section 2.3.3 - Surface Water and Sediment Sampling.

17. Details on the purpose of the proposed surface water and sediment sampling as related to environmental occurrence and potential human exposure should be provided.

18. A stratified, random sampling design is stated as having been used to select the sample locations, although this is not mentioned in the Field Sampling Plan in Appendix B. The method used, outputs, and

assumptions for this statistical sampling design should be presented, although the locations selected do not seem to be statistically based. The sample locations are targeted mainly to previous sample locations and potential discharge areas of concern, which is acceptable based on the current objectives for this sampling, although the limited number of sample locations may not be sufficient to achieve the objectives and DQOs as stated in Sections 2.1 and 2.2, respectively, in the work plan. In addition, many more samples and locations would be needed to achieve a statistically-based sample design with appropriate power and confidence levels, such as by use of the incremental sampling methodology.

19. Although the first paragraph in Section 2.3.3 indicates that surface sediment (0-6 inches below the sediment surface) will only be collected from 15 locations, the rest of the work plan and the FSP in Appendix B- Section 2.10, indicates that surface sediment will in fact be collected from all the planned 26 locations (15 grab sample locations and 11 core sample locations). This discrepancy should be corrected or clarified.
20. Section 2.3.3, Appendix B, and Figures 4 and B-4: The basis for the number of surface water and sediment locations to sample in the vicinity of the Site is not clear. Considering the dynamic nature of the Delaware River due to tidal conditions and the various discharges around the Site, it will be difficult to get an accurate, representative dataset of PFC concentrations around the Site area. In particular, why are 3 surface sediment samples at 11 locations/stations considered acceptable to assess PFC variability? In addition, collection of 3 surface water samples at 11 locations/stations is not really necessary to assess PFC variability, as the water will already be well mixed at each location/station due to the flowing water within the river at each location/station; therefore, the field duplicate samples will be sufficient for this purpose.
21. Section 2.3.3 and Appendix B: At least 1 additional surface water and sediment station with 3 sample locations to assess PFC variability should be added near the outfall from the Solvay on-site treatment plant, as this discharge could affect PFC distribution patterns in the river, even if the on-site treatment system did not treat wastewater containing PFCs.
22. The sediment locations at each station must be targeted to depositional areas. Section 2.10 in the FSP must be revised to add this as a criterion for determining the acceptability of each sample location.
23. Sections 2.3.3 and 3.4, Appendix B, and Figures B-3, and B-4: The difference between sample stations and sample locations is not clearly defined or used in the work plan and the FSP for the surface water and sediment sampling. There are 26 sample locations, but there seem to be 10 sample stations. As one of the objectives is to assess PFC variability at some of the sample locations/stations, the sample identifiers in Section 3.4 of the FSP should be revised to include a sample station number or designation in each sample identifier.
24. Section 2.3.3 and Appendix B: It is recommended that a sediment pore-water sample be collected from at least 1 sample location at each station. Pore water data will allow for assessment of partitioning between sediment and pore water and possible contribution of PFC in sediment to PFC in surface water. If pore water samples will be collected, a SOP for pore water collection should be submitted (see "ECO Update/Ground Water Forum Issue Paper", EPA-540-R-06-072, July 2008 for pore water collection information).



25. Section 2.3.3 and Appendix B, Section 2.9: It is not clear why just a single surface-water sample will be collected at each location or why it will be collected from mid-depth in the water column. It is recommended that a second surface-water sample be collected at each location/station from just above the sediment surface, which will provide data to help assess the contribution of PFC in sediment to PFC in surface water. In addition, collection of depth-integrated samples, in addition to the planned grab samples, would provide a truer representative sample of PFC in the whole water column.

26. Section 2.3.3 and Appendix B : Considering the tidal nature of the Delaware River in the vicinity of the Site, surface water samples from the tidal reach of the river should be collected at both low and high tide. If only one tidal stage will be sampled, then the surface water samples should be collected during low tide. Tidal gauges should be installed to document tidal conditions during sampling.

27. A sampling and core-hole location was proposed at the confluence of the Delaware River and Little Mantua Creek, SS1018 and SS1019. Little Mantua Creek flows along the southern boundary of the Solvay facility. Sediment within Little Mantua Creek would have received surface runoff from the site and received runoff from any potential spills that historically may have occurred at the site. The selected location at the confluence of the creek and the Delaware River would have diluted the concentration in the Little Mantua Creek. Sediment and core sampling should be included in the Little Mantua Creek just downstream from the main industrial manufacturing area.

#### Section 2.4 – Parameters to be Tested and Frequency:

28. Despite the title of this section, no sampling frequency is specified.

29. The analytical methods and laboratories that are planned to be used are certified by NJDEP for a larger suite of PFCs than those listed in Table 4. It is recommended that data on all PFCs from these analyses be provided to NJDEP.

30. A plan of sampling and re-sampling raw and finished water should be developed for each municipal PWS based on the operational history of the well fields. At least one sampling event should be conducted at peak production rates and at seasonal low production rates in each well, since concentrations of PFCs can vary based on seasonal changes and well usage. A clear description of finished water sources should be included with sample reporting.

#### Section 2.5 – Intended Data Usage:

31. As discussed above, the sampling and modeling proposed in this work plan is not sufficient to determine the extent to which long chain PFCs from the site have impacted the environment. Either the limitations of the information that will be obtained from the proposed Work Plan should be made clear, or additional sampling that is needed to fully characterize the extent of PFC occurrence in this vicinity should be included.

#### Section 3 – Reporting

The following comments can be utilized by Solvay when finalizing the Field Sampling Report, which should include data interpretations and recommendations for further investigations:



1. The concentrations of PFCs found in Delaware River water and fish in the DRBC studies should be presented. These findings should be put in context by comparison to levels of these PFCs reported in studies of surface water and fish from other locations.

2. All relevant data on occurrence of PFNA in drinking water in the vicinity of the site, including concentrations detected, should be presented, not just the data from the two NJDEP occurrence studies. This includes the initial USEPA Unregulated Contaminant Monitoring Rule 3 (UCMR3) data recently posted by USEPA at <http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/data.cfm>, data from the 2009 NJDEP study, data from monitoring conducted by water companies that has been reported to NJDEP, and the West Deptford Township Water Department (referred to as "West Deptford MUA" in 12/3/13 letter) submitted to NJDEP by Solvay's LSRP. These PFNA drinking water data from the vicinity of the Solvay site should be put into context by comparison with frequency of detection and levels reported in drinking water studies from other locations.

3. Under the UCMR3, all U.S. public water supplies serving more than 10,000 people and a subset of smaller PWS will monitor for 6 PFCs (PFOA, PFNA, PFHpA, PFOS, PFBS, and PFHxS) and other compounds in finished water at all points of entry to the distribution system in 2013-15. Points of entry using groundwater will be sampled twice and those using surface water will be sampled four times within a 12-month period. See:

[http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/ucmr3/upload/UCMR3\\_FactSheet\\_List1.pdf](http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/ucmr3/upload/UCMR3_FactSheet_List1.pdf)

In the initial UCMR3 dataset (posted by USEPA at <http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/data.cfm>), PFNA was found above the Reporting Level (20 ng/L) in only three of 1007 PWS sampled across the nation. Two of these three detections were in Gloucester County, and PFNA was the only PFC reported in UCMR3 monitoring at these sites. Specifically, PFNA was found at Woodbury City Water Department, about 3.5 miles from the Solvay site, at 46 ng/L in May 2013, and at Monroe Township MUA, about 20 miles south of the Solvay site at 26 ng/L, in January 2013. PFNA was also found at 56 ng/L in a more recent November 2013 sample from Woodbury City Water Department that has been reported to NJDEP but was too recent to be included in the dataset of results through October 2013 posted by USEPA. The only other detection of PFNA in the 1007 PWS reporting in the initial UCMR3 data was in Suffolk County, New York (53 ng/L), where PFHxS was also found at 37 ng/L.

PFNA was found in NJ American Birch Creek-Logan wells, about 10 miles southwest of the Solvay site at up to 72 ng/L. PFNA was also recently found in a West Deptford well at up to 48 ng/L in sampling conducted by Solvay Solexis.

To summarize, PFNA has been found at >20 ng/L in groundwater samples from 5 PWS in Gloucester County: Logan-Birch Creek (up to 72 ng/L), Monroe Township (26 ng/L), Paulsboro (up to 150 ng/L), West Deptford Township (up to 48 ng/L), and Woodbury City (up to 56 ng/L). At two of these sites (Paulsboro – 150 ng/L, and Logan-Birch Creek – 72 ng/L), it was detected above the highest concentration reported in drinking water elsewhere (58 ng/L, Catalonia, Spain; Post et al., 2013). These data indicate that the occurrence of PFNA in groundwater in this vicinity is more widespread than the area in which sampling of PWS is proposed (see below).

4. It should be noted that the Delaware River is not used as a drinking water source in this locality. The major source of potential human exposure from PFCs in the Delaware River is from contaminated fish. Follow-up monitoring of fish to determine current PFC levels would provide useful information

including whether PFC levels have decreased as compared to data that the DRBC has collected in the Delaware River.

5. PFCs in groundwater, whether from migration of the groundwater plume from the site or from air deposition followed by migration through soil to groundwater, is expected to persist and possibly increase despite the cessation of use and emissions of PFCs from the site. A primary concern in this situation is the potential human exposure from use of public or private wells impacted by PFCs from the site. Expansion of the planned sampling of drinking water wells, and possibly soil sampling to help to validate the air modeling results is recommended from the perspective of public health protection.

Figure 4 –

1. Two stations are labeled SSI020. Please indicate which samples (SS1015, SS1016 and SS1017), correspond to the GCUA outfall.

**Appendix A - Quality Assurance Project Plan (QAPP)**

1. Section 1.3.2 – Laboratories: The laboratory certifications for PFCs analysis should be more specific to the matrix and methods, as Eurofins is only certified for PFCs in drinking water, while TestAmerica-Denver is certified for PFCs in drinking water, nonpotable water, and nonaqueous matrices.

Section 2 - Criteria for Measurement Data:

2. Section 2: Completeness should also include the number of samples actually collected and analyzed versus the number of samples planned for collection and analysis, with a goal of 100%. The goal for data completeness should also be 100%, not 90% ((Section 2.4.1).

3. Section 2: Representativeness should include the field duplicates. Evaluation of field duplicate results can use the same equation used for calculating RPD for laboratory precision. This can be used to evaluate the effectiveness of sample homogenization and provide an indication of intrasample variability.

4. Section 2.4.1: A remedy statement for the 90% acceptance level should be included. It is important for project management to have control over suspect data and be able to initiate a resampling effort.

5. Sections 3.2 and 3.4: One paper copy of the data deliverables should be submitted to the Department and with each copy of a report include a copy of the data deliverables on a CD.

6. Sections 3.4 and 14: These two reporting sections should be merged. Although not stated here, it is assumed that all reports will be formatted and include all the information required pursuant to N.J.A.C. 7:26C and N.J.A.C. 7:26E; it is assumed that the report(s) will be equivalent to a site investigation report. Data are to be reported to both the MUAs and (not or) the NJDEP (Section 14).

7. Section 5.1 and Attachments A-1 and A-2: The laboratories' SOPs for the PFCs analytical method should be submitted so the Department can review them as needed during the course of this project, such as during data validation. The Department receives confidential business information all the time and knows how to maintain this CBI.

8. Sections 5.1 and 5.2, and Tables A-1 and A-2: To understand the sediment redox conditions, Eh and pH measurements should be added to Table A-1, the work plan, and FSP. Eh and pH should be measured in the field as soon as possible after the sediment grabs and cores are brought onboard the sampling vessel. An SOP for the Eh and pH measurements will be needed for inclusion in the FSP. Table A-2 should be revised to clarify that pH (and Eh for sediment) will be measured in-situ in the field, so sample bottles and preservation will not be needed, unless these measurements will also be determined at the laboratory.

9. Sections 5.1 and 5.2, and Table A-3: The listed analytical methods should include more complete source references with dates in the table or a note to the table.

10. Sections 5.1 and 5.2, and Tables A-4, A-5, and A-6: It is assumed that the laboratories' SOPs and QC information in the tables conform to EPA Method 537 and all modifications to Method 537 are acceptable based on their certifications.

11. Section 6.2.3: Project samples for each matrix should be used by the laboratories for all MS/MSD samples.

12. Section 10.1.2: The reliability of existing data should be summarized in the report(s).

13. Section 10.1.6. Please identify manager for database in QAPP

14. Section 10.2: Averaging of replicate samples is not acceptable and should be deleted from this section of the QAPP. Averaging replicate results loses the ability to assess variability as stated in the section. In addition, the only replicate data that should be presented in the report(s) is the field duplicate and split sample data (and possibly sample reanalyses depending on the reason for the reanalyses), because each of these samples is a valid standalone sample. Averaging replicate sample results would be allowed only if the individual results are still presented and there is a statistically valid reason to do averaging. Based on the current sampling design, there are not enough replicate analyses for each sample to warrant averaging or statistical analysis of the data. In any case, all data evaluation decisions should be based on the individual sample results. If a statistical evaluation of the sample data is desired, the Department's Office of Science should be consulted for help in planning and designing the statistical evaluation.

15. Section 11: In addition to verbal contact, electronic communications should also be used for coordination of laboratory and field sampling activities. These communications should be documented and included in the project database (Section 10.3).

16. Section 12.2: If SOPs for data validation are not available for inclusion in the QAPP, then a copy of the USEPA guidance (USEPA 2009) should be included.

17. Section 12.2: If 10% of the data deliverables will be selected for full validation, include an estimate of how many total data deliverables are possible. Based on Tables B-3, B-4, and B-5 in the FSP, it seems that no more than 20 data deliverables may be generated (excluding the MUA data), which means just 3 data deliverables would be fully validated (1 initial + 2 for 10%). Considering the sensitivity of and scrutiny to which the PFC data will undergo, 100% validation of all PFC data is strongly recommended (at a minimum, all the MUA data should be validated). For nonPFC data, full validation of all these data is not necessary.

18. Section 12.2: For review of data that will not be fully validated, more details are needed on what is included in a "Stage 2B" validation and whether this will meet the requirement for data usability review at N.J.A.C. 7:26E-1.6(b)9.

19. Section 13: Rejected data may be usable for limited, well defined purposes. Decisions to use rejected data should be discussed and agreed to be all parties.

20. Section 15: The Department's regulations at N.J.A.C. 7:26C and N.J.A.C. 7:26E should be included as references along with all guidance documents applicable to the proposed sampling, such as the ground water investigation and ecological evaluation guidance documents.

21. Table A-5. Tighten up control limits to 20, not 30.

### **Appendix B - Field Sampling Plan**

1. The Field Sampling Plan does not include anything specific regarding sampling of the MUA (PWS) wells and finished water. Addenda to the FSP are mentioned in Section 2.1 of the FSP for this sampling, but the addenda are not included with this submittal, so they could not be reviewed. It is assumed that the MUA (PWS) sample analyses will be compliant with the QAPP in Appendix A. In accordance with the 14 November 2013 e-mail from Gloria Post in the Office of Science, Paulsboro municipal wells 4 and 5 should be sampled, if they have not already been sealed.

2. Section 2.3: Revise to detail how the vertical locational information for each sample will be determined pursuant to N.J.A.C. 7:26E-1.6(a)5ii. Note that for the sediment samples, additional means besides use of the fathometer should be used to confirm the top depth/elevation of sediment, as some locations might have a soupy, soft, uncohesive top layer that the sampling equipment (grab or corer) will sink through and is not suitable for collection and analysis.

3. Section 2.5: The first sentence is garbled or incomplete, so its meaning is not clear.

4. Section 2.7: The decontamination procedures do not conform to any of the 4 procedures included in the NJDEP *Field Sampling Procedures Manual* (August 2005), which is a requirement pursuant to N.J.A.C. 7:26C-1.2(a)3. The departures from the FSPM procedures must be justified (e.g., isopropyl alcohol instead of acetone and rinsing with river water instead of distilled/deionized water). All sample bottles should come precleaned with preservative from the laboratory, so there is no need for field decontamination of sample bottles. If the sample bottles contain preservative for PFCs in accordance with Method 537, then rinsing with river water is not allowed. There is also no mention that aluminum foil is not to be used, and no mention of what material will be used in lieu of aluminum foil to wrap equipment to keep it clean. Finally, considering the very low concentrations of PFCs to be measured, it is not clear why ultra clean decontamination procedures will not be used.

5. Section 2.8 – Per Section 6.9.2.2.5.1 of the NJDEP *Field Sampling Procedures Manual*, low-flow purging and sampling is not an option in wells with screens greater than 5' long unless multiple samples are collected at 5' intervals. Vertical profiling has been conducted at various onsite wells. In such wells, the pump intake should be placed at the depth where the highest concentrations have been detected. If no compounds were detected during vertical profiling (or all concentrations were equal), then the intake may

be placed at the midpoint of the saturated screened interval. In wells where vertical profiling has not been conducted, multiple samples are required at 5' intervals unless adequate justification is provided. In a well with a 90-100' screened interval, for example, a boring log review indicates silt at 90-96' and sand at 96-100'. In such case, the collection of a single sample (with pump intake adjacent to sand interval) may be justified. See the form entitled *Monitor Well Information in Support of Pump Intake Depth Placement* in the FSPM.

6. Section 2.8.1 – Regarding pump decontamination and proposed flushing of the tubing, the use of tap water is not recommended (see comment #10b above). Distilled or deionized water should be used.

7. Section 2.9: The 2 SOPs cited for the surface water sampling include various options that can be used depending on field conditions and the sampling objectives. These details must be spelled out in the FSP, or if they will be selected based on field conditions at the time of sampling, stated as such in the FSP with the decisions documented in the report.

8. Section 2.9: If the multi-probe will be used in-situ to obtain the field measurements, the extra, sacrificial bottle of water (p. 2-8) should be unnecessary, unless this bottle is for storage of the unit between sample locations. Revise to clarify or delete this sentence.

9. Sections 2.9 and 2.10: For the surface water and sediment sampling, revise Sections 2.9 and 2.10 in the FSP so the surface water samples are collected before the sediment samples and collected from downstream to upstream.

10. Section 2.10.1: For the surface sediment sampling, it is not clear why the van Veen grab sampler will be used rather than the corer proposed for the subsurface sediment sampling. The corer should allow for a collection of a surface sediment sample that is less disturbed than from a grab sample and would allow for more accurate sample depth determinations.

11. Sections 2.10.1 and 2.10.2: It is not clear why a composite sediment sample is necessary or how it will be performed. It is assumed that at each surface sediment location (e.g., SSI014) there will be 3 grab samples collected that will then be composited into 1 sample and labeled as 1 sample (e.g., SSI014). Considering the large volume of sediment collected by a van Veen grab sampler, it is not clear why 3 grabs must be collected and composited at each sample location when the sample analyses are limited to PFCs and conventional parameters. Even the core samples should have sufficient volume to make compositing unnecessary.

If samples must be composited, then a SOP is needed for how the compositing will be performed in the field to ensure representative compositing of the grab samples. This is very difficult to perform in the field with wet material that may consist of a silty/clayey matrix that will be difficult to composite or homogenize. Simple mixing in bowl with a spoon is not an acceptable method of compositing. Therefore, compositing is not recommended. There should be sufficient volume in 1 grab sample for the PFC analysis, including the QC samples. If additional volume is needed for the conventional analyses, then these analyses can be performed on a separate grab sample. If compositing will occur, then this is a deviation from the Department's FSPM and *Ecological Evaluation Technical Guidance* that requires justification pursuant to N.J.A.C. 7:26C-1.2(a)3. If each separate sample will be homogenized together into 1 sample and the whole volume sent to the laboratory, then this not a true composite sample and is

acceptable, but if subsamples will be removed and placed into separate sample bottles, then this is just subsampling of a larger volume and is also not true compositing.

12. Section 2.10.2: It is not clear why sample collection intervals will not be adjusted based on separate horizons in the cores. Geochemical conditions change at deeper depths in sediment, which can affect contaminant distribution, fate, and transport. An explanation should be provided why sample collection intervals will not be adjusted to account for separate horizons in the sediment cores.

13. Section 2.10.2: Revise to clarify how the depth intervals to be sampled for analysis will be determined when there is less than 100% recovery in a core. These depth intervals (0-6 in., etc. will be shorter the less recovery in a core and will also vary in length in a core due to compression deeper in a core). In addition, it is not clear why the target depth for the cores is 6 feet. Also pertains to Attachment B2.

14. Section 2.10.2: It is not clear why core acceptability is contingent on a relatively undisturbed sediment surface and overlying water not being excessively turbid, nor why at least 80% core recovery was selected for acceptable recovery. The first 2 criteria could be resolved by collection of a surface grab sample, if this is really an issue. Clarification is needed to better define core recovery versus penetration depth. If 80% recovery really means achieving 80% of the planned sampling depth to 6 feet, then this criterion doesn't seem necessary unless the sampling depth of 6 feet is better justified. Considering the relatively recent and short term use of PFCs at the Solvay facility, sampling to just 2 or 3 feet should be sufficient, unless sediment deposition rates over the past few decades can be determined to set a more useful sampling depth based on the DQO for sediment sampling.

15. Section 2.10.2: Two options are presented for removing the sediment core from the plastic liner. Extruding the sediment core is not a good idea as this will further disturb the core and make determination of sample collection intervals more difficult. Cutting the liners lengthwise is the better option.

16. Section 2.10.2: The use of Teflon®-lined lids as stated in the last paragraph conflicts with the prohibition of Teflon®-containing materials as stated in Section 2.6 of the FSP. Revise Section 2.10.2 to state the correct type of lids to be used.

17. Section 2.11.3: It is not clear why an equipment blank, trip blank, or field blank will not be collected for the sediment sampling, as will be done for the aqueous sampling.

18. Sections 2.10.1 and 2.13: All surface sediment remaining after processing should be containerized for proper disposal as will be done for the subsurface sediment.

19. Section 3.1: While the information proposed for inclusion in the field logbook is acceptable, such information should also be provided in the form of ground water sampling logs. The Low-Flow Sampling Data Sheet in the FSPM (or equivalent) should be provided for each monitor well. It is recommended that each page in the field logbook be dated and signed, not just the last page for each day of sampling.

20. Section 3.4: Some clarifications are needed for the sample identifiers. The examples included are not consistent between the first bullet and the second bullet. For the matrix identifier, it is assumed that SD will not be used for sediment as shown in the second bullet, but GR or CR will be used instead as shown

in the first bullet. For the sample numbers following the matrix identifier, will zeros be used as shown in the second bullet or will zeros not be used as shown in the first bullet? Finally, the examples provided for the blank samples do not seem consistent with what are provided for the field samples and should be linked in the identifier to the location where they are prepared.

21. Section 4: It is assumed that Tables B-3 through B-5 and other forms mentioned in the FSP are field forms, so the use of "if any" in the third line should be deleted.

22. Section 5: The Department's regulations at N.J.A.C. 7:26C and N.J.A.C. 7:26E should be included as references along with all guidance documents applicable to the proposed sampling, such as the FSPM, ground water investigation, and ecological evaluation guidance documents.

✓ 23. Figure B-1: Schedule. Please update the field sampling and reporting schedule as appropriate.



**Azzam, Nidal**

---

**From:** Bergman, Erica <Erica.Bergman@dep.state.nj.us>  
**Sent:** Monday, March 17, 2014 4:41 PM  
**To:** Azzam, Nidal  
**Cc:** Park, Andy  
**Subject:** RE: Solvay  
**Attachments:** Water Treatment BFD.pdf

Nidal,  
Please see my responses below..

Erica Bergman  
NJDEP - Bureau of Case Management  
401 E. State Street - Mail Code 401-05  
P.O. Box 420  
Trenton, NJ 08625-0420  
[erica.bergman@dep.state.nj.us](mailto:erica.bergman@dep.state.nj.us)  
609-292-7406

CASD  
PAD  
DECA  
ERAD  
ORC

1431 Safe Drinking  
Water Act.  
1431

---

**From:** Azzam, Nidal [mailto:Azzam.Nidal@epa.gov]  
**Sent:** Monday, March 17, 2014 12:55 PM  
**To:** Bergman, Erica  
**Cc:** Park, Andy  
**Subject:** Solvay

Hi Erica,

I got your notification about the cancellation of the conference call.

*Solvay and Paulsboro officials are coming to DEP in Trenton to meet with Deputy Commissioner Siekerka to discuss Solvay's Treatability Study on Weds at 10:00. Please let me know if you'd like to attend or conference in (there are several people that can't make it and are conferencing in). I plan to reschedule the monthly technical meeting to discuss progress of other environmental sampling, probably next week some time.*

Is there any update on the installation status of the filtration systems at Solvay, Paulsboro PWS, and at Gloucester treatment facility?

*The treatment for Paulsboro PWS will be discussed at Wednesday's meeting. In the meantime, Paulsboro water officials have been working on the radium contamination in Well #8. It's possible that this system will be in operation in 2 ½ weeks.*

*Solvay's GAC filtration system was installed and became active at their plant on 2/14/14 (see attached flow diagram). This is in addition to an exchange resin system present prior to their partial discharge to GCUA. I inquired about levels of PFNA being discharged to the river and GCUA following treatment due to concerns regarding efficiency. See Mitch Gertz's 2/19/14 response*

below. Also of note, Solvay's NJPDES sampling in Feb would still have untreated water in the system, so March NJPDES sampling event will be the first time we can see results with GAC system in place.

*"I am responding to you email of 2/12 concerning the activated carbon treatment system we are installing. This is an interim treatment system that we could install quickly without significant infrastructure modifications to reduce PFC discharges to the Delaware River. We expect that the interim system will remove about 80% of the PFNA currently discharged to the river from our site. Treatment system performance and operational data will be gathered over about a 4 month period to provide data for the design of a final treatment system. Until we obtain operational data we believe it is premature to estimate concentrations of PFNA discharged to the river."*

Also I haven't received the updated DOH health advisory fact sheet. Did they issue it?

Not to my knowledge, I think it's still undergoing review. This may also be discussed at the meeting on Wednesday. You can contact Joe Eldridge from DOH for the most up to date status. [Joe.Eldridge@doh.state.nj.us](mailto:Joe.Eldridge@doh.state.nj.us)

We have an RA briefing tomorrow. The above two items will more likely be asked about.

Nidal Azzam,  
Base Program Management Section, Chief  
Hazardous Waste Programs Branch  
Clean Air and Sustainability Division  
USEPA Region 2  
290 Broadway, 22nd Floor  
New York, NY 10007  
212-637-3748 Office  
212-637-4437 Fax



**PFC Concentrations (ng/l or ppt) at the East Greenwich PWS (December 19, 2013)**

Chemical Name	Well #2	Well #4	Well #3			
	Raw Water	Raw Water	Raw Water	Raw Water (Duplicate)	Treated Water	Treated Water (Duplicate)
PFOA	ND	ND	4.1	4.2	4.8	5.9
PFOS	ND	ND	2.8	2.7	3.3	3.4
PFNA	ND	ND	21	22	24	23
PFDA	ND	ND	ND	ND	ND	ND
PFUnA	ND	ND	ND	ND	ND	ND
PFDoA	ND	ND	ND	ND	ND	ND
PFTriA	ND	ND	ND	ND	ND	ND

**PFC Concentrations (ng/l or ppt) at the National Park PWS (December 19, 2013)**

Chemical Name	Well #6	Well #5			Borough Hall Tap	
	Raw Water	Raw Water	Treated Water	Treated Water (Duplicate)	Drinking Water	Drinking Water (Duplicate)
PFOA	2.6	2.9	2.8	3.0	3.5	3.3
PFOS	1.8J	1.6J	1.7J	1.6J	1.6J	1.8J
PFNA	11	13	14	15	14	14
PFDA	ND	ND	ND	ND	ND	ND
PFUnA	ND	ND	ND	ND	ND	ND
PFDoA	ND	ND	ND	ND	ND	ND
PFTriA	ND	ND	ND	ND	ND	ND

**PFC Concentrations (mg/l or ppt) at the Paulsboro MUA (November 26, 2013)**

Chemical Name	Well #8	Well #9	Well #7			
	Raw Water	Raw Water	Raw Water	Raw Water (Duplicate)	Treated Water	Treated Water (Duplicate)
PFOA	19	34	23	24	26	27
PFOS	15	1.6J	4.8	4.9	5.7	5.9
PFNA	15	7.4	92	88	96	110
PFDA	0.78J	ND	0.39J	0.41J	0.57J	0.42J
PFUnA	0.76J	ND	0.77J	0.46J	1.2J	0.74J
PFDoA	ND	ND	ND	ND	ND	ND
PFTriA	ND	ND	ND	ND	ND	ND

**PFC Concentrations (mg/l or ppt) at the West Deptford MUA (October 30, 2013)**

[illegible]

**PFC Concentrations (n/l or ppt) at the Westville PWS (December 12, 2013)**

Chemical Name	Well #4	Well #6	Well #5			
	Raw Water	Raw Water	Raw Water	Raw Water (Duplicate)	Treated Water	Treated Water (Duplicate)
PFOA	ND	1.7J	3.9	4.0	4.2	4.2
PFOS	ND	ND	1.7J	1.8J	1.9J	1.8J
PFNA	ND	0.77J	8.0	7.7	8.3	8.2
PFDA	ND	ND	ND	ND	ND	ND
PFUnA	ND	ND	ND	ND	ND	ND
PFDoA	ND	ND	ND	ND	ND	ND
PFTriA	ND	ND	ND	ND	ND	ND

**PFC Concentrations (ng/l or ppt) at the Woodbury PWS (December 12, 2013)**

[illegible]

PFUnA	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFDoA	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFTriA	ND	ND	ND	ND	ND	ND	ND	ND	ND

PFC Concentrations (ng/l or ppt) at Solvay under NJPDES Permit NJ0005185

Chemical Name	November 21, 2013		December 17, 2013	
	Influent (V904)	Effluent (V915)	Influent (V904)	Effluent (V915)
PFOA	1,300	1,600	1,500	1,100
PFOS	1.9J	1.5J	5.7	3.4
PFNA	12,000	14,000	16,000	9,000
PFDA	56	62	130	51
PFUnA	210	190	370	140
PFDoA	0.98J	0.6J	2.1J	0.94J
PFTriA	0.91J	ND	1.5J	1.0J
PFBS	0.74J	0.78J	3.1	2.1J
PFHpA	140	150	150	110
PFHxS	1.8J	2.0J	3.7	4.4
PFHxA	53	56	56	46
PFTeA	ND	ND	ND	ND

**SRWM**

**Perfluorinated Chemicals (PFCs) in Paulsboro Wells (1/17/14 update)**  
(nanograms per liter; parts per trillion)

<i>Well/ Treatment Plant</i>	<i>Date</i>	<i>PFHxA (C6)</i>	<i>PFHpA (C7)</i>	<i>PFOA (C8)</i>	<i>PFNA (C9)</i>	<i>PFDA (C10)</i>	<i>PFBS (C4-S)</i>	<i>PFHxS (C6-S)</i>	<i>PFOS (C8-S)</i>
Well 7 (raw)	8/19/09	6	<5	26	<b>96</b>	<5	<5	<5	10
Well 7 (treated)	3/8/11	---	---	27	---	---	---	---	12
Well 7 (treated)	6/4/11	---	---	24	---	---	---	---	10
Well 7 (treated)	8/23/11	---	---	30	---	---	---	---	13
Well 7 (treated)	2/7/12	---	---	34	---	---	---	---	15
Well 7* (raw)	9/17/13	4.9	3.8	32	<b>140</b>	<2.5	<25	4.4	6.0
Well 7* (treated)	9/17/13	5.0	4.0	35	<b>150</b>	<2.5	<25	4.7	7.4
Well 7** (raw)	11/26/13	---	---	23/24	<b>92/88</b>	J/J	---	---	4.8/4.9
Well 7** (treated)	11/26/13	---	---	26/27	<b>96/110</b>	J	---	---	5.7/5.9
Well 8 (raw)	9/17/13	6.8	3.7	19	15	<2.5	<25	5.9	8.4
Well 8 (treated)	9/17/13	6.4	4.0	18	16	<2.5	<25	6.1	9.0
Well 8** (raw)	11/26/13	---	---	19	15	J	---	---	15
Well 4 (treated, used until 5/12)	3/8/11	---	---	33	---	---	---	---	20
Well 4 (treated, used until 5/12)	6/4/11	---	---	25	---	---	---	---	14
Well 4 (treated, used until 5/12)	8/23/11	---	---	35	---	---	---	---	24
Well 4 (treated, used until 5/12)	2/7/12	---	---	<b>42***</b>	---	---	---	---	26
Well 5 (treated, used until 5/12)	3/8/11	---	---	<b>96</b>	---	---	---	---	23
Well 5 (treated, used until 5/12)	6/4/11	---	---	<b>81</b>	---	---	---	---	21
Well 5 (treated, used until 5/12)	8/23/11	---	---	<b>42</b>	---	---	---	---	18
Well 5 (treated, used until 5/12)	2/7/12	---	---	33	---	---	---	---	14
Well 9* (raw – not in use)	9/17/13	8.5	3.5	<b>53</b>	10	<2.5	<25	3.5	4
Well 9** (raw, inactive)	11/26/13	---	---	34	7.4	<2.5	---	---	J

**NOTES: TREATED WATER WELLS are in BOLD.**

\* C11, C12, C13, and C14 were analyzed in these samples and were not detected (<2.5 ng/L).

\*\* 11/26/13 samples taken by Solvay. Data quality review by DEP Office of Data Quality has not yet been completed. Well #7 samples were split between two labs. J means detected below Reporting Level. C11 was also detected below Reporting Level (J) in samples from Wells 7 and 8.

---- Not Analyzed.

\*\*\* PFOA data in GREEN exceeds NJ PFOA guidance of 40 ng/L.



**Perfluorinated Chemicals (PFCs) in Paulsboro Wells (1/17/14 update)**  
(nanograms per liter; parts per trillion)

<i>Well/ Treatment Plant</i>	<i>Date</i>	<i>PFHxA (C6)</i>	<i>PFHpA (C7)</i>	<i>PFOA (C8)</i>	<i>PFNA (C9)</i>	<i>PFDA (C10)</i>	<i>PFBS (C4-S)</i>	<i>PFHxS (C6-S)</i>	<i>PFOS (C8-S)</i>
Well 7 (raw)	8/19/09	6	<5	26	<b>96</b>	<5	<5	<5	10
Well 7 (treated)	3/8/11	---	---	27	---	---	---	---	12
Well 7 (treated)	6/4/11	---	---	24	---	---	---	---	10
Well 7 (treated)	8/23/11	---	---	30	---	---	---	---	13
Well 7 (treated)	2/7/12	---	---	34	---	---	---	---	15
Well 7* (raw)	9/17/13	4.9	3.8	32	<b>140</b>	<2.5	<25	4.4	6.0
Well 7* (treated)	9/17/13	5.0	4.0	35	<b>150</b>	<2.5	<25	4.7	7.4
Well 7** (raw)	11/26/13	---	---	23/24	<b>92/88</b>	J/J	---	---	4.8/4.9
Well 7** (treated)	11/26/13	---	---	26/27	<b>96/110</b>	J	---	---	5.7/5.9
Well 8 (raw)	9/17/13	6.8	3.7	19	15	<2.5	<25	5.9	8.4
Well 8 (treated)	9/17/13	6.4	4.0	18	16	<2.5	<25	6.1	9.0
Well 8** (raw)	11/26/13	---	---	19	15	J	---	---	15
Well 4 (treated, used until 5/12)	3/8/11	---	---	33	---	---	---	---	20
Well 4 (treated, used until 5/12)	6/4/11	---	---	25	---	---	---	---	14
Well 4 (treated, used until 5/12)	8/23/11	---	---	35	---	---	---	---	24
Well 4 (treated, used until 5/12)	2/7/12	---	---	<b>42***</b>	---	---	---	---	26
Well 5 (treated, used until 5/12)	3/8/11	---	---	<b>96</b>	---	---	---	---	23
Well 5 (treated, used until 5/12)	6/4/11	---	---	<b>81</b>	---	---	---	---	21
Well 5 (treated, used until 5/12)	8/23/11	---	---	<b>42</b>	---	---	---	---	18
Well 5 (treated, used until 5/12)	2/7/12	---	---	33	---	---	---	---	14
Well 9* (raw – not in use)	9/17/13	8.5	3.5	<b>53</b>	10	<2.5	<25	3.5	4
Well 9** (raw, inactive)	11/26/13	---	---	34	7.4	<2.5	---	---	J

**NOTES: TREATED WATER WELLS are in BOLD.**

\* C11, C12, C13, and C14 were analyzed in these samples and were not detected ( $\leq 2.5$  ng/L).

\*\* 11/26/13 samples taken by Solvay. Data quality review by DEP Office of Data Quality has not yet been completed. Well #7 samples were split between two labs. J means detected below Reporting Level. C11 was also detected below Reporting Level (J) in samples from Wells 7 and 8.

---- Not Analyzed.

\*\*\* PFOA data in GREEN exceeds NJ PFOA guidance of 40 ng/L.

**Perfluorinated Chemicals (PFCs) in Paulsboro Wells (1/17/14 update)**  
(nanograms per liter; parts per trillion)

<i>Well/ Treatment Plant</i>	<i>Date</i>	<i>PFHxA (C6)</i>	<i>PFHpA (C7)</i>	<i>PFOA (C8)</i>	<i>PFNA (C9)</i>	<i>PFDA (C10)</i>	<i>PFBS (C4-S)</i>	<i>PFHxS (C6-S)</i>	<i>PFOS (C8-S)</i>
Well 7 (raw)	8/19/09	6	<5	26	96	<5	<5	<5	10
Well 7 (treated)	3/8/11	---	---	27	---	---	---	---	12
Well 7 (treated)	6/4/11	---	---	24	---	---	---	---	10
Well 7 (treated)	8/23/11	---	---	30	---	---	---	---	13
Well 7 (treated)	2/7/12	---	---	34	---	---	---	---	15
Well 7* (raw)	9/17/13	4.9	3.8	32	140	<2.5	<25	4.4	6.0
Well 7* (treated)	9/17/13	5.0	4.0	35	150	<2.5	<25	4.7	7.4
Well 7** (raw)	11/26/13	---	---	23/24	92/88	J/J	---	---	4.8/4.9
Well 7** (treated)	11/26/13	---	---	26/27	96/110	J	---	---	5.7/5.9
Well 8 (raw)	9/17/13	6.8	3.7	19	15	<2.5	<25	5.9	8.4
Well 8 (treated)	9/17/13	6.4	4.0	18	16	<2.5	<25	6.1	9.0
Well 8** (raw)	11/26/13	---	---	19	15	J	---	---	15
Well 4 (treated, used until 5/12)	3/8/11	---	---	33	---	---	---	---	20
Well 4 (treated, used until 5/12)	6/4/11	---	---	25	---	---	---	---	14
Well 4 (treated, used until 5/12)	8/23/11	---	---	35	---	---	---	---	24
Well 4 (treated, used until 5/12)	2/7/12	---	---	42***	---	---	---	---	26
Well 5 (treated, used until 5/12)	3/8/11	---	---	96	---	---	---	---	23
Well 5 (treated, used until 5/12)	6/4/11	---	---	81	---	---	---	---	21
Well 5 (treated, used until 5/12)	8/23/11	---	---	42	---	---	---	---	18
Well 5 (treated, used until 5/12)	2/7/12	---	---	33	---	---	---	---	14
Well 9* (raw – not in use)	9/17/13	8.5	3.5	53	10	<2.5	<25	3.5	4
Well 9** (raw, inactive)	11/26/13	---	---	34	7.4	<2.5	---	---	J

**NOTES: TREATED WATER WELLS are in BOLD.**

\* C11, C12, C13, and C14 were analyzed in these samples and were not detected ( $\leq 2.5$  ng/L).

\*\* 11/26/13 samples taken by Solvay. Data quality review by DEP Office of Data Quality has not yet been completed. Well #7 samples were split between two labs. J means detected below Reporting Level. C11 was also detected below Reporting Level (J) in samples from Wells 7 and 8.

---- Not Analyzed.

\*\*\* PFOA data in GREEN exceeds NJ PFOA guidance of 40 ng/L.

**Perfluorinated Chemicals (PFCs) in Paulsboro Wells (1/17/14 update)**  
(nanograms per liter; parts per trillion)

<i>Well/ Treatment Plant</i>	<i>Date</i>	<i>PFHxA (C6)</i>	<i>PFHpA (C7)</i>	<i>PFOA (C8)</i>	<i>PFNA (C9)</i>	<i>PFDA (C10)</i>	<i>PFBS (C4-S)</i>	<i>PFHxS (C6-S)</i>	<i>PFOS (C8-S)</i>
Well 7 (raw)	8/19/09	6	<5	26	96	<5	<5	<5	10
Well 7 (treated)	3/8/11	---	---	27	---	---	---	---	12
Well 7 (treated)	6/4/11	---	---	24	---	---	---	---	10
Well 7 (treated)	8/23/11	---	---	30	---	---	---	---	13
Well 7 (treated)	2/7/12	---	---	34	---	---	---	---	15
Well 7* (raw)	9/17/13	4.9	3.8	32	140	<2.5	<25	4.4	6.0
Well 7* (treated)	9/17/13	5.0	4.0	35	150	<2.5	<25	4.7	7.4
Well 7** (raw)	11/26/13	---	---	23/24	92/88	J/J	---	---	4.8/4.9
Well 7** (treated)	11/26/13	---	---	26/27	96/110	J	---	---	5.7/5.9
Well 8 (raw)	9/17/13	6.8	3.7	19	15	<2.5	<25	5.9	8.4
Well 8 (treated)	9/17/13	6.4	4.0	18	16	<2.5	<25	6.1	9.0
Well 8** (raw)	11/26/13	---	---	19	15	J	---	---	15
Well 4 (treated, used until 5/12)	3/8/11	---	---	33	---	---	---	---	20
Well 4 (treated, used until 5/12)	6/4/11	---	---	25	---	---	---	---	14
Well 4 (treated, used until 5/12)	8/23/11	---	---	35	---	---	---	---	24
Well 4 (treated, used until 5/12)	2/7/12	---	---	42***	---	---	---	---	26
Well 5 (treated, used until 5/12)	3/8/11	---	---	96	---	---	---	---	23
Well 5 (treated, used until 5/12)	6/4/11	---	---	81	---	---	---	---	21
Well 5 (treated, used until 5/12)	8/23/11	---	---	42	---	---	---	---	18
Well 5 (treated, used until 5/12)	2/7/12	---	---	33	---	---	---	---	14
Well 9* (raw – not in use)	9/17/13	8.5	3.5	53	10	<2.5	<25	3.5	4
Well 9** (raw, inactive)	11/26/13	---	---	34	7.4	<2.5	---	---	J

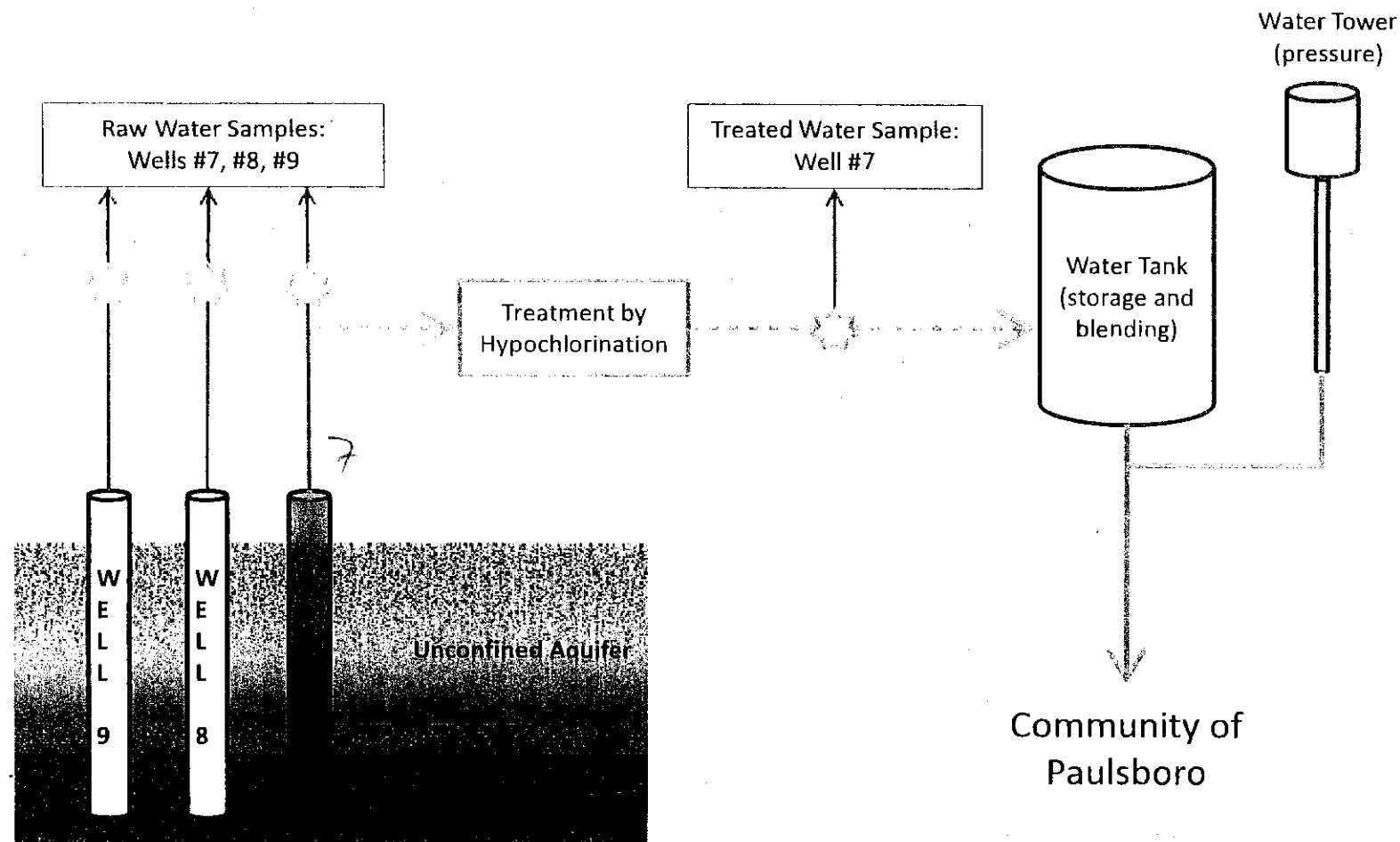
**NOTES: TREATED WATER WELLS are in BOLD.**

\* C11, C12, C13, and C14 were analyzed in these samples and were not detected (<2.5 ng/L).

\*\* 11/26/13 samples taken by Solvay. Data quality review by DEP Office of Data Quality has not yet been completed. Well #7 samples were split between two labs. J means detected below Reporting Level. C11 was also detected below Reporting Level (J) in samples from Wells 7 and 8.

---- Not Analyzed.

\*\*\* PFOA data in GREEN exceeds NJ PFOA guidance of 40 ng/L.



**Notes**

Distance between wells is greater than the diagram suggests. Wells #8 and #9, located on Summit Ave, are separated from Well #7 by several miles. Depths and screening intervals are not available at this time. All three wells pump from the Potomac-Raritan-Magothy (PRM) confined aquifer and there is no supplemental water supply. Only Well #7 was supplying water at the time of sampling. Wells #8 and #9 are undergoing additional treatment to reduce radium, aluminum, and iron and increase pH. All three wells were in working order and available for raw water sampling.

Table 1. PFC Concentrations from Samples Collected November 26, 2013 at the Paulsboro MUA <sup>a</sup>

Chemical Name	Well #8	Well #9	Well #7			
	RW	RW	RW	RW-Dup	TW	TW-Dup
PFOA	19	34	23	24	26	27
PFOS	15	1.6 J	4.8	4.9	5.7	5.9
PFNA	15	7.4	92	88	96	110
PFDA	0.78 J	--	0.39 J	0.41 J	0.57 J	0.42 J
PFUnA	0.76 J	--	0.77 J	0.46 J	1.2 J	0.74 J
PFDoDA	--	--	--	--	--	--
PFTriA	--	--	--	--	--	--

## Notes:

MUA = Municipal Utility Authority

PFC = perfluorinated compound

RW = raw water

RW-Dup = raw water laboratory duplicate sample

TW = treated well water (these samples are indicative of the concentrations in drinking water at the time of sampling - see Figure 1)

TW-Dup = treated well water laboratory duplicate sample

-- = analyte was not detected at the calculated method detection limit

J = result was detected at or greater than the method detection limit and less than method reporting limit

<sup>a</sup> Units for all results are parts per trillion (ppt).

Table 2. Federal and State PFC Guidelines for Drinking Water

Agency	Chemical Name <sup>a</sup>						
	PFOA	PFOS	PFNA	PFDA	PFUnA	PFDODA	PFTriA
U.S. Environmental Protection Agency <sup>b</sup>	400	200	--	--	--	--	--
North Carolina Department of Environmental and Natural Resources <sup>c</sup>	200	--	--	--	--	--	--
New Jersey Department of Environmental Protection <sup>d</sup>	40	20	--	--	--	--	--
Minnesota Department of Health <sup>e</sup>	300	300	--	--	--	--	--

## Sources:

USEPA. 2009. Provisional Health advisories for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). Available at:

[http://water.epa.gov/action/advisories/drinking/upload/2009\\_01\\_15\\_criteria\\_drinking\\_pfa-PFOA\\_PFOS.pdf](http://water.epa.gov/action/advisories/drinking/upload/2009_01_15_criteria_drinking_pfa-PFOA_PFOS.pdf). U.S. Environmental Protection Agency. 5 pp. January 8.

NJDEP. 2007. Determination of perfluorooctanoic acid (PFOA) in aqueous samples. Final Report. New Jersey Department of Environmental Protection, Division of Water Supply, Bureau of Safe Drinking Water, Trenton, NJ. 17 pp. January.

NCDENR. 2013. Appendix #1: Interim maximum allowable concentrations (IMACs). pp. 23-24. In: North Carolina Administrative Code Title 15A - Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina. Last amended April 1. Available at: <http://portal.ncdenr.org/web/wq/ps/csu/gwstandards>. North Carolina Department of Environmental and Natural Resources, Division of Water Quality, Raleigh, NC. 31 pp.

MDH. 2013. Health guidelines for perfluorochemicals (PFCs) in drinking water. [www.health.state.mn.us/divs/eh/hazardous/topics/pfcs/drinkingwater.html](http://www.health.state.mn.us/divs/eh/hazardous/topics/pfcs/drinkingwater.html). Minnesota Department of Health, Environmental Health Division, St. Paul, MN.

## Notes:

PFC = perfluorinated compound

-- = provisional guidelines are not available for drinking water

<sup>a</sup> Units for all results are parts per trillion (ppt).

<sup>b</sup> USEPA (2009) provisional drinking water advisory for short-term exposure.

<sup>c</sup> NCDENR (2013) recommended interim maximum allowable concentration (IMAC) in drinking water, effective date December 6, 2006.

<sup>d</sup> NJDEP (2007) health-based guidance value intended to protect for chronic (lifetime) exposure.

<sup>e</sup> MDH (2011) health risk limit (HRL) in drinking water for chronic exposure.



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Laboratory Hits  
Report: 459150

Integral Consulting Inc.  
Craig Hutchings  
1205 West Bay Drive NW  
Olympia, WA 98502

Samples Received on:  
11/27/2013

Analyzed	Analyte	Sample ID	Result	Federal MCL	Units	MRL
	<b>201311270036</b>	<b><u>GW0001</u></b>				
12/09/2013 18:55	Perfluorononanoic acid		0.015		ug/L	0.0025
12/09/2013 18:55	Perfluorooctanesulfonic acid		0.015		ug/L	0.0025
12/09/2013 18:55	Perfluorooctanoic acid		0.019		ug/L	0.0025
	<b>201311270037</b>	<b><u>GW0002</u></b>				
12/09/2013 19:15	Perfluorononanoic acid		0.0074		ug/L	0.0025
12/09/2013 19:15	Perfluorooctanoic acid		0.034		ug/L	0.0025
	<b>201311270038</b>	<b><u>GW0003</u></b>				
12/09/2013 19:36	Perfluorononanoic acid		0.092		ug/L	0.025
12/02/2013 22:34	Perfluorooctanesulfonic acid		0.0048		ug/L	0.0025
12/02/2013 22:34	Perfluorooctanoic acid		0.023		ug/L	0.0025
	<b>201311270039</b>	<b><u>GW0004</u></b>				
12/09/2013 19:56	Perfluorononanoic acid		0.088		ug/L	0.025
12/02/2013 22:54	Perfluorooctanesulfonic acid		0.0049		ug/L	0.0025
12/02/2013 22:54	Perfluorooctanoic acid		0.024		ug/L	0.0025
	<b>201311270040</b>	<b><u>GW0005</u></b>				
12/09/2013 20:16	Perfluorononanoic acid		0.096		ug/L	0.025
12/02/2013 23:14	Perfluorooctanesulfonic acid		0.0057		ug/L	0.0025
12/02/2013 23:14	Perfluorooctanoic acid		0.026		ug/L	0.0025
	<b>201311270041</b>	<b><u>GW0006</u></b>				
12/09/2013 20:36	Perfluorononanoic acid		0.11		ug/L	0.025
12/02/2013 23:34	Perfluorooctanesulfonic acid		0.0059		ug/L	0.0025
12/02/2013 23:34	Perfluorooctanoic acid		0.027		ug/L	0.0025

**SUMMARY OF POSITIVE DATA ONLY**



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Samples Received on:  
11/27/2013

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MDL	MRL	Dilution
<b>GW0001 (201311270036)</b>					<b>Sampled on 11/26/2013 0945</b>				
Variable ID: C1165									
<b>EPA 537 - Perfluorinated Alkyl Acids</b>									
12/6/2013	12/09/2013	18:55	740931	(EPA 537) Perfluorodecanoic acid	0.00078J	ug/L	0.0003	0.0025	1
12/6/2013	12/09/2013	18:55	740931	(EPA 537) Perfluorododecanoic acid	ND(R6)	ug/L	0.0006	0.0025	1
12/6/2013	12/09/2013	18:55	740931	(EPA 537) Perfluorononanoic acid	0.015	ug/L	0.0004	0.0025	1
12/6/2013	12/09/2013	18:55	740931	(EPA 537) Perfluorooctanesulfonic acid	0.015	ug/L	0.0002	0.0025	1
12/6/2013	12/09/2013	18:55	740931	(EPA 537) Perfluorooctanoic acid	0.019	ug/L	0.0002	0.0025	1
12/6/2013	12/09/2013	18:55	740931	(EPA 537) Perfluorotetradecanoic acid	ND	ug/L	0.001	0.0025	1
12/6/2013	12/09/2013	18:55	740931	(EPA 537) Perfluorotridecanoic acid	ND	ug/L	0.0008	0.0025	1
12/6/2013	12/09/2013	18:55	740931	(EPA 537) Perfluoroundecanoic acid	0.00076J	ug/L	0.0004	0.0025	1
12/6/2013	12/09/2013	18:55	740931	(EPA 537) 13C-PFDA	70	%			1
12/6/2013	12/09/2013	18:55	740931	(EPA 537) 13C-PFOA	103	%			1
12/6/2013	12/09/2013	18:55	740931	(EPA 537) 13C-PFOS	108	%			1
<b>GW0002 (201311270037)</b>					<b>Sampled on 11/26/2013 1011</b>				
Variable ID: C1165									
<b>EPA 537 - Perfluorinated Alkyl Acids</b>									
12/6/2013	12/09/2013	19:15	740931	(EPA 537) Perfluorodecanoic acid	ND	ug/L	0.0003	0.0025	1
12/6/2013	12/09/2013	19:15	740931	(EPA 537) Perfluorododecanoic acid	ND(R6)	ug/L	0.0006	0.0025	1
12/6/2013	12/09/2013	19:15	740931	(EPA 537) Perfluorononanoic acid	0.0074	ug/L	0.0004	0.0025	1
12/6/2013	12/09/2013	19:15	740931	(EPA 537) Perfluorooctanesulfonic acid	0.0016J	ug/L	0.0002	0.0025	1
12/6/2013	12/09/2013	19:15	740931	(EPA 537) Perfluorooctanoic acid	0.034	ug/L	0.0002	0.0025	1
12/6/2013	12/09/2013	19:15	740931	(EPA 537) Perfluorotetradecanoic acid	ND	ug/L	0.001	0.0025	1
12/6/2013	12/09/2013	19:15	740931	(EPA 537) Perfluorotridecanoic acid	ND	ug/L	0.0008	0.0025	1
12/6/2013	12/09/2013	19:15	740931	(EPA 537) Perfluoroundecanoic acid	ND	ug/L	0.0004	0.0025	1
12/6/2013	12/09/2013	19:15	740931	(EPA 537) 13C-PFDA	71	%			1
12/6/2013	12/09/2013	19:15	740931	(EPA 537) 13C-PFOA	103	%			1
12/6/2013	12/09/2013	19:15	740931	(EPA 537) 13C-PFOS	109	%			1
<b>GW0003 (201311270038)</b>					<b>Sampled on 11/26/2013 1040</b>				
Variable ID: C1165									
<b>EPA 537 - Perfluorinated Alkyl Acids</b>									
11/30/2013	12/02/2013	22:34	739952	(EPA 537) Perfluorodecanoic acid	0.00039J	ug/L	0.0003	0.0025	1
11/30/2013	12/02/2013	22:34	739952	(EPA 537) Perfluorododecanoic acid	ND	ug/L	0.0006	0.0025	1
11/30/2013	12/09/2013	19:36	740931	(EPA 537) Perfluorononanoic acid	0.092	ug/L	0.0004	0.0025	10

ending on totals after summation.

J - Indicates calculated results

ND - Analyte was not detected at the calculated MDL.

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Report: 459150

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Samples Received on:  
11/27/2013

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MDL	MRL	Dilution	
11/30/2013	12/02/2013	22:34	739952	(EPA 537)	Perfluorooctanesulfonic acid	0.0048	ug/L	0.0002	0.0025	1
11/30/2013	12/02/2013	22:34	739952	(EPA 537)	Perfluorooctanoic acid	0.023	ug/L	0.0002	0.0025	1
11/30/2013	12/02/2013	22:34	739952	(EPA 537)	Perfluorotetradecanoic acid	ND	ug/L	0.001	0.0025	1
11/30/2013	12/02/2013	22:34	739952	(EPA 537)	Perfluorotridecanoic acid	ND	ug/L	0.0008	0.0025	1
11/30/2013	12/02/2013	22:34	739952	(EPA 537)	Perfluoroundecanoic acid	0.00077J	ug/L	0.0004	0.0025	1
11/30/2013	12/02/2013	22:34	739952	(EPA 537)	13C-PFDA	76	%			1
11/30/2013	12/02/2013	22:34	739952	(EPA 537)	13C-PFOA	91	%			1
11/30/2013	12/02/2013	22:34	739952	(EPA 537)	13C-PFOS	84	%			1

**GW0004 (201311270039)**

Sampled on 11/26/2013 1046

Variable ID: C1165

**EPA 537 - Perfluorinated Alkyl Acids**

11/30/2013	12/02/2013	22:54	739952	(EPA 537)	Perfluorodecanoic acid	0.00041J	ug/L	0.0003	0.0025	1
11/30/2013	12/02/2013	22:54	739952	(EPA 537)	Perfluorododecanoic acid	ND	ug/L	0.0006	0.0025	1
11/30/2013	12/09/2013	19:56	740931	(EPA 537)	Perfluorononanoic acid	0.088	ug/L	0.0004	0.025	10
11/30/2013	12/02/2013	22:54	739952	(EPA 537)	Perfluorooctanesulfonic acid	0.0049	ug/L	0.0002	0.0025	1
11/30/2013	12/02/2013	22:54	739952	(EPA 537)	Perfluorooctanoic acid	0.024	ug/L	0.0002	0.0025	1
11/30/2013	12/02/2013	22:54	739952	(EPA 537)	Perfluorotetradecanoic acid	ND	ug/L	0.001	0.0025	1
11/30/2013	12/02/2013	22:54	739952	(EPA 537)	Perfluorotridecanoic acid	ND	ug/L	0.0008	0.0025	1
11/30/2013	12/02/2013	22:54	739952	(EPA 537)	Perfluoroundecanoic acid	0.00046J	ug/L	0.0004	0.0025	1
11/30/2013	12/02/2013	22:54	739952	(EPA 537)	13C-PFDA	73	%			1
11/30/2013	12/02/2013	22:54	739952	(EPA 537)	13C-PFOA	92	%			1
11/30/2013	12/02/2013	22:54	739952	(EPA 537)	13C-PFOS	96	%			1

**GW0005 (201311270040)**

Sampled on 11/26/2013 1105

Variable ID: C1165

**EPA 537 - Perfluorinated Alkyl Acids**

11/30/2013	12/02/2013	23:14	739952	(EPA 537)	Perfluorodecanoic acid	0.00057J	ug/L	0.0003	0.0025	1
11/30/2013	12/02/2013	23:14	739952	(EPA 537)	Perfluorododecanoic acid	ND	ug/L	0.0006	0.0025	1
11/30/2013	12/09/2013	20:16	740931	(EPA 537)	Perfluorononanoic acid	0.096	ug/L	0.0004	0.025	10
11/30/2013	12/02/2013	23:14	739952	(EPA 537)	Perfluorooctanesulfonic acid	0.0057	ug/L	0.0002	0.0025	1
11/30/2013	12/02/2013	23:14	739952	(EPA 537)	Perfluorooctanoic acid	0.026	ug/L	0.0002	0.0025	1
11/30/2013	12/02/2013	23:14	739952	(EPA 537)	Perfluorotetradecanoic acid	ND	ug/L	0.001	0.0025	1
11/30/2013	12/02/2013	23:14	739952	(EPA 537)	Perfluorotridecanoic acid	ND	ug/L	0.0008	0.0025	1
11/30/2013	12/02/2013	23:14	739952	(EPA 537)	Perfluoroundecanoic acid	0.0012J	ug/L	0.0004	0.0025	1
11/30/2013	12/02/2013	23:14	739952	(EPA 537)	13C-PFDA	88	%			1

Rounding on totals after summation

(c) - Indicates calculated results

ND - Analyte was not detected at the calculated MDL

J - The analyte was either detected at or greater than the MDL and less than the MRL, or did not meet any one of the required QC criteria.

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Laboratory Data  
Report: 459150

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Olympia, WA 98502

Samples Received on:  
11/27/2013

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MDL	MRL	Dilution
11/30/2013	12/02/2013	23:14	739952	(EPA 537)	13C-PFOA	90	%		1
11/30/2013	12/02/2013	23:14	739952	(EPA 537)	13C-PFOS	96	%		1

**GW0006 (201311270041)**

Variable ID: C1165

Sampled on 11/26/2013 1100

**EPA 537 - Perfluorinated Alkyl Acids**

11/30/2013	12/02/2013	23:34	739952	(EPA 537)	Perfluorodecanoic acid	0.00042J	ug/L	0.0003	0.0025	1
11/30/2013	12/02/2013	23:34	739952	(EPA 537)	Perfluorododecanoic acid	ND	ug/L	0.0006	0.0025	1
11/30/2013	12/09/2013	20:36	740931	(EPA 537)	Perfluorononanoic acid	0.11	ug/L	0.0004	0.025	10
11/30/2013	12/02/2013	23:34	739952	(EPA 537)	Perfluorooctanesulfonic acid	0.0059	ug/L	0.0002	0.0025	1
11/30/2013	12/02/2013	23:34	739952	(EPA 537)	Perfluorooctanoic acid	0.027	ug/L	0.0002	0.0025	1
11/30/2013	12/02/2013	23:34	739952	(EPA 537)	Perfluorotetradecanoic acid	ND	ug/L	0.001	0.0025	1
11/30/2013	12/02/2013	23:34	739952	(EPA 537)	Perfluorotridecanoic acid	ND	ug/L	0.0008	0.0025	1
11/30/2013	12/02/2013	23:34	739952	(EPA 537)	Perfluoroundecanoic acid	0.00074J	ug/L	0.0004	0.0025	1
11/30/2013	12/02/2013	23:34	739952	(EPA 537)	13C-PFDA	88	%			1
11/30/2013	12/02/2013	23:34	739952	(EPA 537)	13C-PFOA	89	%			1
11/30/2013	12/02/2013	23:34	739952	(EPA 537)	13C-PFOS	93	%			1

**GW0007 (201311270042)**

Variable ID: C1165

Sampled on 11/26/2013 1142

**EPA 537 - Perfluorinated Alkyl Acids**

11/30/2013	12/02/2013	23:55	739952	(EPA 537)	Perfluorodecanoic acid	ND	ug/L	0.0003	0.0025	1
11/30/2013	12/02/2013	23:55	739952	(EPA 537)	Perfluorododecanoic acid	ND	ug/L	0.0006	0.0025	1
11/30/2013	12/02/2013	23:55	739952	(EPA 537)	Perfluorononanoic acid	ND	ug/L	0.0004	0.0025	1
11/30/2013	12/02/2013	23:55	739952	(EPA 537)	Perfluorooctanesulfonic acid	ND	ug/L	0.0002	0.0025	1
11/30/2013	12/02/2013	23:55	739952	(EPA 537)	Perfluorooctanoic acid	ND	ug/L	0.0002	0.0025	1
11/30/2013	12/02/2013	23:55	739952	(EPA 537)	Perfluorotetradecanoic acid	ND	ug/L	0.001	0.0025	1
11/30/2013	12/02/2013	23:55	739952	(EPA 537)	Perfluorotridecanoic acid	ND	ug/L	0.0008	0.0025	1
11/30/2013	12/02/2013	23:55	739952	(EPA 537)	Perfluoroundecanoic acid	ND	ug/L	0.0004	0.0025	1
11/30/2013	12/02/2013	23:55	739952	(EPA 537)	13C-PFDA	91	%			1
11/30/2013	12/02/2013	23:55	739952	(EPA 537)	13C-PFOA	97	%			1
11/30/2013	12/02/2013	23:55	739952	(EPA 537)	13C-PFOS	97	%			1

\*Rounding on totals after summation.

J - Indicates calculated results

ND - Analyte was not detected at the calculated MDL.

J - The analyte was either detected at or greater than the MDL and less than the MRL, or did not meet any one of the required QC criteria.

Solvay Specialty Polymers USA, LLC.,  
10 Leonard Lane  
West Deptford, New Jersey 08096

RE: Perfluorinated Compounds (PFCs) Work Plan

NJDEP and USEPA-RCRA, along with contributions from other groups (Delaware River Basin Commission, Delaware Riverkeeper Network, USEPA National Exposure Research Laboratories) have reviewed the Perfluorinated Compounds (PFCs) Work Plan submitted on November 15, 2013 to investigate the occurrence of PFC contamination in drinking water and the environment and offer the following comments:

### **General Comments**

1. It is suggested that data on PFC concentrations in water be given in ng/L instead of µg/L. This is the current convention in papers and reports presenting these data, and the data are more easily understandable in these units.
2. The term "Municipal Utility Authority (MUA)" is used throughout to refer to public community water supplies (PWS). This term is often used to refer to wastewater treatment plants (publicly owned treatment works) such as Gloucester County MUA and Camden County MUA, as well as municipally owned public water systems. It is suggested that the term "public community water systems" or "PWS" be used instead. It should be noted that, although the 7 public community water supplies for which sampling is proposed are all "municipal" (e.g. publicly owned), this is not necessarily the case for all public community water supplies in the vicinity. Many public community water supplies are privately owned – for example, the NJ American Ranney Station and Logan-Birch Creek facilities ("PWS A" and "PWS B" in Post et al., 2013).
3. Main Text and Appendix B: The Field Sampling Plan (FSP) in Appendix B should have been merged and presented with the main text. It is confusing and made the review more difficult than it had to be to have the work plan information placed in two separate areas in the document. Where there is overlap between the two, comments may apply to both the main text and the FSP.

### **Section 1 - Project Background**

1. DEP and USEPA provide oversight of Solvay remediation additionally under RCRA 2020 Corrective Action Program.
2. The objectives of the effort described in the Work Plan are not well described and should be more clearly defined. For example, the objective could be "to evaluate the geographic and temporal extent of environmental occurrence of perfluorinated compounds related to their use at the Solvay Specialty Polymers site" or "to conduct a preliminary investigation of environmental occurrence and dispersion of PFCs related to their use at the Solvay Specialty Polymers site in order to gather information that will guide decisions about further characterization of the site in the future" or some other clearly stated objective.

3. Additionally, the reasons that the presence of perfluorinated compounds may be present in the environment and are of potential concern in this vicinity should be stated. Solvay has provided data on historic annual releases of PFCs to air and water from this site in a separate table. The fact that these releases occurred over a period of about 25 years (1985-2010) should be mentioned. Potential routes of human exposures should also be briefly mentioned. For example, occurrence in public water supplies may lead to human exposure through drinking water; the Delaware River is not used as a drinking water source in this location but PFCs could be taken up into fish (of potential concern due to fish consumption and/or ecological effects), etc.

4. The sampling and modeling proposed by Solvay are not sufficient to fully characterize the fate and occurrence of PFCs discharged from the site. No justification is given for how the 7 PWS for which sampling is proposed were chosen. Comparison of the locations of public community water supply wells proposed to be tested (shown on the map in Figure 2 of the work plan) with the map of drinking water wells near the site developed by the NJDEP GIS group reveals that there are a number of additional public community water supply wells very close to those proposed to be tested that are not included. Additionally, the available data indicates that PFNA from the site has likely reached public community water supplies more distant from the site than the area in which sampling is proposed. Importantly, there are private wells and several public non-community wells in this locality. These wells are at least as vulnerable to PFC contamination as the public water system wells (PWS) and should be sampled.

4. Historical information on the treatment of wastewater from processes that used PFCs at the site should be provided, including the fate of the sludge from treatment of this wastewater. At the September 2013 meeting with NJDEP and USEPA, Solvay said that the wastewater containing organic contaminants is currently treated by Gloucester County MUA. Was the organic wastewater from the site sent to Gloucester County MUA for the entire period since 1985? See comment #8.

#### Section 1.2: Historical Operations and Activities at the Site:

5. As above, information on the annual amounts of perfluorinated compounds used and discharged at the site was provided by Solvay in a separate table. This table should be included in the work plan and referenced in this section, since it provides important information on historical operations at the site. Additionally, historical information on the fate of wastewater and the sludge from the treated wastewater, as well as any off-site disposal in landfills should be discussed here.

6. Include any soils remediation conducted by Solvay or its predecessors that included on-site disposal of soils.

7. Please indicate whether sources that created the organic chlorinated contamination would also have had PFC compounds, which may have led to similar migration pathways.

8. Include any information known on the origination of dredge spoils that are now located on the northern area of the site. If the material was dredged in the manufacturing period of the facility, it is a potential PFC source. If the dredge material remains a possible release source then it should be addressed in the work plan. The dredge material needs to be evaluated as a source to the shallow ground water both pre and post cap. If releases occur to the shallow ground water within or beneath the dredge material further PFC migration either to river discharge and infiltration into the PRM Aquifer may have or may be occurring.

9. The description and composition of Surflon is unclear and should be clarified. The term “telomer-based fluorosurfactant” used to describe Surflon is confusing to the reader. Is this term used because the perfluorinated carboxylates in Surflon were made by the telomerization process (as opposed to other processes for manufacture of PFCs), or because fluorinated telomers are also present in the mixture? According to Prevedouros et al. (2006), Surflon S-111 is “a commercial product (CAS 72968-3-88), [that] is described as ‘Fatty acids, C7-13, perfluoro, ammonium salts’ a mixture of PFCAs between seven and thirteen carbons in length” containing 0.78% PFOA (C8), 74% PFNA (C9), 0.37 % PFDA (C10), 20% PFUnDA (C11), and 0.1% PFDD (C12), and 5% PFTD (C13). It should be stated that Surflon is a mixture of long chain perfluorinated carboxylates, and the percentage (or range of percentages) of each compound in the mixture should be provided. It would be helpful to include the CAS numbers and structures of these compounds.

#### Section 1.3.2 - Municipal Utility Authority Occurrence Studies:

10. The statement that PFOA concentrations of  $> 40$  ng/L were found in at least one sample from 12% of PWS in the 2006 NJDEP study (NJDEP, 2007; Post et al., 2009) is not accurate. None of the samples in the 2006 NJDEP study exceeded 40 ng/L for PFOA. PFOA at  $\geq 40$  ng/L was found in subsequent follow-up samples from some of these PWS at the same or different points of entry tested in the 2006 NJDEP study. Also, PFOA at  $\geq 40$  ng/L was found in two of the 31 PWS tested by NJDEP in 2009, as well as in some PWS not included in either study that submitted monitoring data to NJDEP.

11. Of the three PWS with PFNA at  $\geq 40$  ng/L reported in Post et al. (2013), two were included in the 2009 NJDEP study (Paulsboro Water Dept. and Southeast Morris County MUA) and the third (NJ American Logan-Birch Creek) was one of the two additional PWS reporting ongoing monitoring data on the same 10 PFCs to NJDEP.

### Section 2 - Proposed Workplan

#### Section 2.1 - Objectives:

1. The overall objective for the proposed project is not clearly stated, but the proposed work plan appears to be an initial screening effort rather than a complete characterization. The overall objective should be clearly stated. For example, “to characterize the geographic extent and magnitude of the occurrence of PFCs in environmental media in the vicinity of the Solvay site,” or “to conduct initial sampling of the occurrence of PFCs in environmental media in the vicinity of the Solvay site to aid in decision-making for future sampling and modeling,” or something else if appropriate.

If the intent is to conduct an initial screening, it should be clearly stated how the results of this initial sampling will be used to determine what, if any, additional sampling will be conducted to fully characterize the extent of PFC occurrence in environmental media in this locality.

2. The analytical methods that will be used are certified to analyze a broader suite of PFCs than C8 to C13. It is recommended that data for all PFCs for which these methods are certified by NJDEP be reported.

3. Text in the second paragraph states: “The air modeling results are expected to describe the potential extent and geographical distribution of historical deposition patterns.” Dr. Alex Polissar, Office of Science air modeler, has reviewed the air modeling proposed in Appendix C. Although he is not familiar with the specific details of the AERMOD, the proposed plan looks reasonable to him. However, large

uncertainties related to different factors, such as sources of PFNA and other PFCs and their emission rates, meteorology, particle size distribution assumptions, dispersion modeling itself, etc., will produce air modeling results with large uncertainties. It will be difficult to draw any firm conclusions on the geographical extent and magnitude of contamination of the area by using the results of the air modeling alone. Dr. Andrew Lindstrom, USEPA National Exposure Research Laboratories, emphasizes that soil sampling can provide important information to support and validate the predictions of the air modeling. The available data from PWS in Gloucester County (discussed above) suggests that the geographical distribution of PFNA from the Solvay site is much more widespread than the area in which sampling has been proposed. Therefore, the available environmental monitoring data (groundwater, soil etc.) should be used along with the air modeling results to characterize the extent of PFC occurrence in this locality. See also citations in Section 2.2. below.

4. Again, as above, the overall purpose of describing the potential extent and geographical distribution of historical deposition patterns should be described. Specifically, if further sampling is planned in areas where historical deposition may have occurred not included in this work plan, it should be so stated. The work plan does not fully address potential historic runoff from the manufacturing facility area. On-site soils are not being sampled until, possibly, after the completion of the air dispersion and deposition model. Please describe any potential sources of spills and soil remediation areas that could produce contaminated runoff. These data gaps in soil concentration and runoff potential should be addressed with the results of the air dispersion and deposition model.

5. As previously discussed, Greg John from the DEP Air Program will also review and comment on the proposed air modeling. Receipt of additional information regarding input files from Solvay is pending. Please forward this information as soon as available so a full review can be conducted.

#### Section 2.2 – Data Quality Objectives:

6. The overall project objective should be stated. The planned sampling and air modeling listed here would provide a preliminary screening assessment, but not a full characterization of the extent of PFNA occurrence in this locality.

7. As above, sampling of the seven PWS mentioned in the Work Plan is not sufficient to characterize the extent of groundwater contamination and potential human exposure through drinking water. Additional public community water supplies, as well as public non-community water supplies and private wells should be sampled. A DQO should be added to assess PFC concentrations in the municipal water supplies (and the on-site wells?) against the NJDEP preliminary health-based guidance value of 0.04 µg/L for PFOA as cited in Section 1.3.2.

8. The DQOs for the surface water and sediment sampling seem to be incomplete. Based on the locations mentioned in Section 2.3.3, it seems that one of the main objectives is to confirm the previous data collected in the Delaware River, as the previous DRBC locations will be sampled. If this is the case, then inclusion of all PFCs analyzed in those investigations is recommended. In addition, a detection limit equivalent to the DRBC 2007, 2008 and 2009 studies at 1 to 2 ng/L for PFC in surface water should be achieved in the proposed work. If Solvay is unable or unwilling to expand the list of PFC analytes, the DRBC recommends split samples for the Delaware River surface water samples to be submitted to Test America for the 7 PFC proposed in the work plan and to Axys Analytical, the original laboratory used in the 2007 to 2009 surveys. The new surface water samples would be analyzed for 13 PFC, 3 fluorotelomer sulfonates and 10 phosphorus based per/poly fluoroalkyl substances at Axys Analytical. The DRBC is



able to support this effort with available monitoring funds at a level not to exceed \$31,000. Additional discussion will be needed to coordinate the split samples.

9. In conjunction with air modeling to determine the potential extent of aerial distribution of PFCs, the potential for PFCs migration to groundwater after deposition from air onto soil could be evaluated using approaches previously developed by others. See the following two papers:

Paustenbach DJ, Panko JM, Scott PK, Unice KM. 2007/ A methodology for estimating human exposure to perfluorooctanoic acid (PFOA): a retrospective exposure assessment of a community (1951-2003). *J Toxicol Environ Health A*. 70(1):28-57.

Shin HM, Vieira VM, Ryan PB, Detwiler R, Sanders B, Steenland K, Bartell SM. 2011. Environmental fate and transport modeling for perfluorooctanoic acid emitted from the Washington Works Facility in West Virginia. *Environ Sci Technol*. 45(4):1435-42.

10. It is stated on page 2-2 that the Data Quality Objectives are consistent with "Guidance on Systematic Planning Using the Data Quality Objectives Process (USEPA, 2006). This document is found at: <http://www.epa.gov/quality/qs-docs/g4-final.pdf>. Although the names of the steps in the Table 3 of the Work Plan are similar to (but not identical) to the names of the steps in the USEPA Data Quality Objectives Process (Figure 2, p. 8 of USEPA (2006), the descriptions of the steps in the Work Plan are not consistent with USEPA (2006). If USEPA (2006) is to be cited as the model for the Data Quality Objectives, Table 3 should be revised to be consistent with the process provided by USEPA (2006). Particularly, the major outputs for each step, and the examples for each step, provided in USEPA (2006) should be used as a guide. See below:

1. *State the Problem.* The overall problem is not stated clearly stated, is not sufficiently broad, and is not presented in enough detail, based on the process and examples provided in USEPA (2006).

2. *Identify the Decision.* This step is called "Identify Goals of the Study" in USEPA (2006). The description of this step in Table 3 does not include the principal outputs for this step described by USEPA (2006), particularly a list of alternative outcomes or actions or a decision statement. See principal outputs and examples in USEPA (2006).

3. *Identify Inputs to the Decision.* This step is called "Identify Information Inputs" by USEPA (2006). According to the process provided in USEPA (2006), this step should include more than simply the analytical methods and QAPP. See principal outputs and examples in USEPA (2006).

4. *Define the Boundaries.* The rationale for determining the boundaries of the investigation is not provided here or elsewhere. "Nearby" MUA facilities is a vague statement with no rationale provided. As discussed above, it is not clear why offsite monitoring wells are not included, available data indicates the need to sample additional public community water systems than those included in the draft Work Plan, private wells and public non-community water supplies. Soil sampling would also be useful in evaluating the extent of contamination.

5. *Develop a Decision Rule.* This step is called "Develop the Analytic Approach" by USEPA (2006). Based on the process and examples provided in USEPA (2006), the description of this step should be broader than as written in the draft Work Plan.

It is stated that no additional work will be performed if the PACSRC results are satisfactory and the sampling results meet the project objectives. The actions that will be taken if the results are not satisfactory or do not meet the project objectives should be provided.

6. *Specify Limits on Decision Errors.* This step is called "Specify Performance or Acceptance Criteria" by USEPA (2006).

7. *Optimize the Design for Obtaining Data.* This step is called "Develop the Detailed Plan for Obtaining Data" by USEPA (2006). According the process and examples provided by USEPA (2006), more detail should be provided on the work plan than is provided here.

#### Section 2.3.1: MUA Sampling

11. As above, change terminology to PWS sampling.

12. Inactive Paulsboro municipal wells 4 and 5 should be sampled, if they have not already been sealed.

13. The rationale for limiting sampling to these seven PWS is unclear. It should be clarified that, while NJDEP provided information on the locations of PWS in the vicinity of the Solvay site, NJDEP did not recommend that sampling be limited to these PWS. As discussed above, available information indicates that PFNA has reached additional PWS more distant than the seven mentioned here, and that sampling of PWS over a larger area should be conducted. Additionally, public non-community water supplies and private wells in the same geographic area should be sampled. Please include a plan to sample additional community and non-community PWS wells and private drinking water wells for PFCs in an iterative manner (stepping out to sample additional wells when contamination is found).

#### Section 2.3.2 - Groundwater sampling

14. There are multiple complexities within the Potomac-Raritan-Magothy (PRM) aquifer in the region, including multiple aquifer zones, multiple confining zones, the induced infiltration from the Delaware River, and shifting Public Supply well production. At a minimum, a ground water flow and transport model may be required to understand the PFC distribution once the first sets of data has been collected.

15. The inclusion of MW-ID is recommended; for a total of 32 wells due to historically elevated levels of contaminants in this well. Among other areas, it is stated that wells were selected "...within the axes..." Please clarify.

16. Please indicate that additional groundwater sampling extending offsite will be conducted in an iterative manner to determine the extent of groundwater contamination by PFCs.

#### Section 2.3.3 - Surface Water and Sediment Sampling.

17. Details on the purpose of the proposed surface water and sediment sampling as related to environmental occurrence and potential human exposure should be provided.

18. A stratified, random sampling design is stated as having been used to select the sample locations, although this is not mentioned in the Field Sampling Plan in Appendix B. The method used, outputs, and

assumptions for this statistical sampling design should be presented, although the locations selected do not seem to be statistically based. The sample locations are targeted mainly to previous sample locations and potential discharge areas of concern, which is acceptable based on the current objectives for this sampling, although the limited number of sample locations may not be sufficient to achieve the objectives and DQOs as stated in Sections 2.1 and 2.2, respectively, in the work plan. In addition, many more samples and locations would be needed to achieve a statistically-based sample design with appropriate power and confidence levels, such as by use of the incremental sampling methodology.

19. Although the first paragraph in Section 2.3.3 indicates that surface sediment (0-6 inches below the sediment surface) will only be collected from 15 locations, the rest of the work plan and the FSP in Appendix B- Section 2.10, indicates that surface sediment will in fact be collected from all the planned 26 locations (15 grab sample locations and 11 core sample locations). This discrepancy should be corrected or clarified.

20. Section 2.3.3, Appendix B, and Figures 4 and B-4: The basis for the number of surface water and sediment locations to sample in the vicinity of the Site is not clear. Considering the dynamic nature of the Delaware River due to tidal conditions and the various discharges around the Site, it will be difficult to get an accurate, representative dataset of PFC concentrations around the Site area. In particular, why are 3 surface sediment samples at 11 locations/stations considered acceptable to assess PFC variability? In addition, collection of 3 surface water samples at 11 locations/stations is not really necessary to assess PFC variability, as the water will already be well mixed at each location/station due to the flowing water within the river at each location/station; therefore, the field duplicate samples will be sufficient for this purpose.

21. Section 2.3.3 and Appendix B: At least 1 additional surface water and sediment station with 3 sample locations to assess PFC variability should be added near the outfall from the Solvay on-site treatment plant, as this discharge could affect PFC distribution patterns in the river, even if the on-site treatment system did not treat wastewater containing PFCs.

22. The sediment locations at each station must be targeted to depositional areas. Section 2.10 in the FSP must be revised to add this as a criterion for determining the acceptability of each sample location.

23. Sections 2.3.3 and 3.4, Appendix B, and Figures B-3, and B-4: The difference between sample stations and sample locations is not clearly defined or used in the work plan and the FSP for the surface water and sediment sampling. There are 26 sample locations, but there seem to be 10 sample stations. As one of the objectives is to assess PFC variability at some of the sample locations/stations, the sample identifiers in Section 3.4 of the FSP should be revised to include a sample station number or designation in each sample identifier.

24. Section 2.3.3 and Appendix B: It is recommended that a sediment pore-water sample be collected from at least 1 sample location at each station. Pore water data will allow for assessment of partitioning between sediment and pore water and possible contribution of PFC in sediment to PFC in surface water. If pore water samples will be collected, a SOP for pore water collection should be submitted (see "ECO Update/Ground Water Forum Issue Paper", EPA-540-R-06-072, July 2008 for pore water collection information).

25. Section 2.3.3 and Appendix B, Section 2.9: It is not clear why just a single surface-water sample will be collected at each location or why it will be collected from mid-depth in the water column. It is recommended that a second surface-water sample be collected at each location/station from just above the sediment surface, which will provide data to help assess the contribution of PFC in sediment to PFC in surface water. In addition, collection of depth-integrated samples, in addition to the planned grab samples, would provide a truer representative sample of PFC in the whole water column.

26. Section 2.3.3 and Appendix B : Considering the tidal nature of the Delaware River in the vicinity of the Site, surface water samples from the tidal reach of the river should be collected at both low and high tide. If only one tidal stage will be sampled, then the surface water samples should be collected during low tide. Tidal gauges should be installed to document tidal conditions during sampling.

27. A sampling and core-hole location was proposed at the confluence of the Delaware River and Little Mantua Creek, SS1018 and SS1019. Little Mantua Creek flows along the southern boundary of the Solvay facility. Sediment within Little Mantua Creek would have received surface runoff from the site and received runoff from any potential spills that historically may have occurred at the site. The selected location at the confluence of the creek and the Delaware River would have diluted the concentration in the Little Mantua Creek. Sediment and core sampling should be included in the Little Mantua Creek just downstream from the main industrial manufacturing area.

#### Section 2.4 – Parameters to be Tested and Frequency:

28. Despite the title of this section, no sampling frequency is specified.

29. The analytical methods and laboratories that are planned to be used are certified by NJDEP for a larger suite of PFCs than those listed in Table 4. It is recommended that data on all PFCs from these analyses be provided to NJDEP.

30. A plan of sampling and re-sampling raw and finished water should be developed for each municipal PWS based on the operational history of the well fields. At least one sampling event should be conducted at peak production rates and at seasonal low production rates in each well, since concentrations of PFCs can vary based on seasonal changes and well usage. A clear description of finished water sources should be included with sample reporting.

#### Section 2.5 – Intended Data Usage:

31. As discussed above, the sampling and modeling proposed in this work plan is not sufficient to determine the extent to which long chain PFCs from the site have impacted the environment. Either the limitations of the information that will be obtained from the proposed Work Plan should be made clear, or additional sampling that is needed to fully characterize the extent of PFC occurrence in this vicinity should be included.

### Section 3 – Reporting

The following comments can be utilized by Solvay when finalizing the Field Sampling Report, which should include data interpretations and recommendations for further investigations:

1. The concentrations of PFCs found in Delaware River water and fish in the DRBC studies should be presented. These findings should be put in context by comparison to levels of these PFCs reported in studies of surface water and fish from other locations.

2. All relevant data on occurrence of PFNA in drinking water in the vicinity of the site, including concentrations detected, should be presented, not just the data from the two NJDEP occurrence studies. This includes the initial USEPA Unregulated Contaminant Monitoring Rule 3 (UCMR3) data recently posted by USEPA at <http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/data.cfm>, data from the 2009 NJDEP study, data from monitoring conducted by water companies that has been reported to NJDEP, and the West Deptford Township Water Department (referred to as "West Deptford MUA" in 12/3/13 letter) submitted to NJDEP by Solvay's LSRP. These PFNA drinking water data from the vicinity of the Solvay site should be put into context by comparison with frequency of detection and levels reported in drinking water studies from other locations.

3. Under the UCMR3, all U.S. public water supplies serving more than 10,000 people and a subset of smaller PWS will monitor for 6 PFCs (PFOA, PFNA, PFHpA, PFOS, PFBS, and PFHxS) and other compounds in finished water at all points of entry to the distribution system in 2013-15. Points of entry using groundwater will be sampled twice and those using surface water will be sampled four times within a 12-month period. See:

[http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/ucmr3/upload/UCMR3\\_FactSheet\\_List1.pdf](http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/ucmr3/upload/UCMR3_FactSheet_List1.pdf)

In the initial UCMR3 dataset (posted by USEPA at <http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/data.cfm>), PFNA was found above the Reporting Level (20 ng/L) in only three of 1007 PWS sampled across the nation. Two of these three detections were in Gloucester County, and PFNA was the only PFC reported in UCMR3 monitoring at these sites. Specifically, PFNA was found at Woodbury City Water Department, about 3.5 miles from the Solvay site, at 46 ng/L in May 2013, and at Monroe Township MUA, about 20 miles south of the Solvay site at 26 ng/L, in January 2013. PFNA was also found at 56 ng/L in a more recent November 2013 sample from Woodbury City Water Department that has been reported to NJDEP but was too recent to be included in the dataset of results through October 2013 posted by USEPA. The only other detection of PFNA in the 1007 PWS reporting in the initial UCMR3 data was in Suffolk County, New York (53 ng/L), where PFHxS was also found at 37 ng/L.

PFNA was found in NJ American Birch Creek-Logan wells, about 10 miles southwest of the Solvay site at up to 72 ng/L. PFNA was also recently found in a West Deptford well at up to 48 ng/L in sampling conducted by Solvay Solexis.

To summarize, PFNA has been found at >20 ng/L in groundwater samples from 5 PWS in Gloucester County: Logan-Birch Creek (up to 72 ng/L), Monroe Township (26 ng/L), Paulsboro (up to 150 ng/L), West Deptford Township (up to 48 ng/L), and Woodbury City (up to 56 ng/L). At two of these sites (Paulsboro – 150 ng/L, and Logan-Birch Creek – 72 ng/L), it was detected above the highest concentration reported in drinking water elsewhere (58 ng/L, Catalonia, Spain; Post et al., 2013). These data indicate that the occurrence of PFNA in groundwater in this vicinity is more widespread than the area in which sampling of PWS is proposed (see below).

4. It should be noted that the Delaware River is not used as a drinking water source in this locality. The major source of potential human exposure from PFCs in the Delaware River is from contaminated fish. Follow-up monitoring of fish to determine current PFC levels would provide useful information

including whether PFC levels have decreased as compared to data that the DRBC has collected in the Delaware River.

5. PFCs in groundwater, whether from migration of the groundwater plume from the site or from air deposition followed by migration through soil to groundwater, is expected to persist and possibly increase despite the cessation of use and emissions of PFCs from the site. A primary concern in this situation is the potential human exposure from use of public or private wells impacted by PFCs from the site. Expansion of the planned sampling of drinking water wells, and possibly soil sampling to help to validate the air modeling results is recommended from the perspective of public health protection.

Figure 4 –

1. Two stations are labeled SSI020. Please indicate which samples (SS1015, SS1016 and SS1017), correspond to the GCUA outfall.

**Appendix A - Quality Assurance Project Plan (QAPP)**

1. Section 1.3.2 – Laboratories: The laboratory certifications for PFCs analysis should be more specific to the matrix and methods, as Eurofins is only certified for PFCs in drinking water, while TestAmerica-Denver is certified for PFCs in drinking water, nonpotable water, and nonaqueous matrices.

Section 2 - Criteria for Measurement Data:

2. Section 2: Completeness should also include the number of samples actually collected and analyzed versus the number of samples planned for collection and analysis, with a goal of 100%. The goal for data completeness should also be 100%, not 90% ((Section 2.4.1).

3. Section 2: Representativeness should include the field duplicates. Evaluation of field duplicate results can use the same equation used for calculating RPD for laboratory precision. This can be used to evaluate the effectiveness of sample homogenization and provide an indication of intrasample variability.

4. Section 2.4.1: A remedy statement for the 90% acceptance level should be included. It is important for project management to have control over suspect data and be able to initiate a resampling effort.

5. Sections 3.2 and 3.4: One paper copy of the data deliverables should be submitted to the Department and with each copy of a report include a copy of the data deliverables on a CD.

6. Sections 3.4 and 14: These two reporting sections should be merged. Although not stated here, it is assumed that all reports will be formatted and include all the information required pursuant to N.J.A.C. 7:26C and N.J.A.C. 7:26E; it is assumed that the report(s) will be equivalent to a site investigation report. Data are to be reported to both the MUAs and (not or) the NJDEP (Section 14).

7. Section 5.1 and Attachments A-1 and A-2: The laboratories' SOPs for the PFCs analytical method should be submitted so the Department can review them as needed during the course of this project, such as during data validation. The Department receives confidential business information all the time and knows how to maintain this CBI.

8. Sections 5.1 and 5.2, and Tables A-1 and A-2: To understand the sediment redox conditions, Eh and pH measurements should be added to Table A-1, the work plan, and FSP. Eh and pH should be measured in the field as soon as possible after the sediment grabs and cores are brought onboard the sampling vessel. An SOP for the Eh and pH measurements will be needed for inclusion in the FSP. Table A-2 should be revised to clarify that pH (and Eh for sediment) will be measured in-situ in the field, so sample bottles and preservation will not be needed, unless these measurements will also be determined at the laboratory.

9. Sections 5.1 and 5.2, and Table A-3: The listed analytical methods should include more complete source references with dates in the table or a note to the table.

10. Sections 5.1 and 5.2, and Tables A-4, A-5, and A-6: It is assumed that the laboratories' SOPs and QC information in the tables conform to EPA Method 537 and all modifications to Method 537 are acceptable based on their certifications.

11. Section 6.2.3: Project samples for each matrix should be used by the laboratories for all MS/MSD samples.

12. Section 10.1.2: The reliability of existing data should be summarized in the report(s).

13. Section 10.1.6. Please identify manager for database in QAPP

14. Section 10.2: Averaging of replicate samples is not acceptable and should be deleted from this section of the QAPP. Averaging replicate results loses the ability to assess variability as stated in the section. In addition, the only replicate data that should be presented in the report(s) is the field duplicate and split sample data (and possibly sample reanalyses depending on the reason for the reanalyses), because each of these samples is a valid standalone sample. Averaging replicate sample results would be allowed only if the individual results are still presented and there is a statistically valid reason to do averaging. Based on the current sampling design, there are not enough replicate analyses for each sample to warrant averaging or statistical analysis of the data. In any case, all data evaluation decisions should be based on the individual sample results. If a statistical evaluation of the sample data is desired, the Department's Office of Science should be consulted for help in planning and designing the statistical evaluation.

15. Section 11: In addition to verbal contact, electronic communications should also be used for coordination of laboratory and field sampling activities. These communications should be documented and included in the project database (Section 10.3).

16. Section 12.2: If SOPs for data validation are not available for inclusion in the QAPP, then a copy of the USEPA guidance (USEPA 2009) should be included.

17. Section 12.2: If 10% of the data deliverables will be selected for full validation, include an estimate of how many total data deliverables are possible. Based on Tables B-3, B-4, and B-5 in the FSP, it seems that no more than 20 data deliverables may be generated (excluding the MUA data), which means just 3 data deliverables would be fully validated (1 initial + 2 for 10%). Considering the sensitivity of and scrutiny to which the PFC data will undergo, 100% validation of all PFC data is strongly recommended (at a minimum, all the MUA data should be validated). For nonPFC data, full validation of all these data is not necessary.



18. Section 12.2: For review of data that will not be fully validated, more details are needed on what is included in a "Stage 2B" validation and whether this will meet the requirement for data usability review at N.J.A.C. 7:26E-1.6(b)9.

19. Section 13: Rejected data may be usable for limited, well defined purposes. Decisions to use rejected data should be discussed and agreed to be all parties.

20. Section 15: The Department's regulations at N.J.A.C. 7:26C and N.J.A.C. 7:26E should be included as references along with all guidance documents applicable to the proposed sampling, such as the ground water investigation and ecological evaluation guidance documents.

21. Table A-5. Tighten up control limits to 20, not 30.

#### **Appendix B - Field Sampling Plan**

1. The Field Sampling Plan does not include anything specific regarding sampling of the MUA (PWS) wells and finished water. Addenda to the FSP are mentioned in Section 2.1 of the FSP for this sampling, but the addenda are not included with this submittal, so they could not be reviewed. It is assumed that the MUA (PWS) sample analyses will be compliant with the QAPP in Appendix A. In accordance with the 14 November 2013 e-mail from Gloria Post in the Office of Science, Paulsboro municipal wells 4 and 5 should be sampled, if they have not already been sealed.

2. Section 2.3: Revise to detail how the vertical locational information for each sample will be determined pursuant to N.J.A.C. 7:26E-1.6(a)5ii. Note that for the sediment samples, additional means besides use of the fathometer should be used to confirm the top depth/elevation of sediment, as some locations might have a soupy, soft, uncohesive top layer that the sampling equipment (grab or corer) will sink through and is not suitable for collection and analysis.

3. Section 2.5: The first sentence is garbled or incomplete, so its meaning is not clear.

4. Section 2.7: The decontamination procedures do not conform to any of the 4 procedures included in the NJDEP *Field Sampling Procedures Manual* (August 2005), which is a requirement pursuant to N.J.A.C. 7:26C-1.2(a)3. The departures from the FSPM procedures must be justified (e.g., isopropyl alcohol instead of acetone and rinsing with river water instead of distilled/deionized water). All sample bottles should come precleaned with preservative from the laboratory, so there is no need for field decontamination of sample bottles. If the sample bottles contain preservative for PFCs in accordance with Method 537, then rinsing with river water is not allowed. There is also no mention that aluminum foil is not to be used, and no mention of what material will be used in lieu of aluminum foil to wrap equipment to keep it clean. Finally, considering the very low concentrations of PFCs to be measured, it is not clear why ultra clean decontamination procedures will not be used.

5. Section 2.8 – Per Section 6.9.2.2.5.1 of the NJDEP *Field Sampling Procedures Manual*, low-flow purging and sampling is not an option in wells with screens greater than 5' long unless multiple samples are collected at 5' intervals. Vertical profiling has been conducted at various onsite wells. In such wells, the pump intake should be placed at the depth where the highest concentrations have been detected. If no compounds were detected during vertical profiling (or all concentrations were equal), then the intake may



be placed at the midpoint of the saturated screened interval. In wells where vertical profiling has not been conducted, multiple samples are required at 5' intervals unless adequate justification is provided. In a well with a 90-100' screened interval, for example, a boring log review indicates silt at 90-96' and sand at 96-100'. In such case, the collection of a single sample (with pump intake adjacent to sand interval) may be justified. See the form entitled *Monitor Well Information in Support of Pump Intake Depth Placement* in the FSPM.

6. Section 2.8.1 – Regarding pump decontamination and proposed flushing of the tubing, the use of tap water is not recommended (see comment #10b above). Distilled or deionized water should be used.

7. Section 2.9: The 2 SOPs cited for the surface water sampling include various options that can be used depending on field conditions and the sampling objectives. These details must be spelled out in the FSP, or if they will be selected based on field conditions at the time of sampling, stated as such in the FSP with the decisions documented in the report.

8. Section 2.9: If the multi-probe will be used in-situ to obtain the field measurements, the extra, sacrificial bottle of water (p. 2-8) should be unnecessary, unless this bottle is for storage of the unit between sample locations. Revise to clarify or delete this sentence.

9. Sections 2.9 and 2.10: For the surface water and sediment sampling, revise Sections 2.9 and 2.10 in the FSP so the surface water samples are collected before the sediment samples and collected from downstream to upstream.

10. Section 2.10.1: For the surface sediment sampling, it is not clear why the van Veen grab sampler will be used rather than the corer proposed for the subsurface sediment sampling. The corer should allow for a collection of a surface sediment sample that is less disturbed than from a grab sample and would allow for more accurate sample depth determinations.

11. Sections 2.10.1 and 2.10.2: It is not clear why a composite sediment sample is necessary or how it will be performed. It is assumed that at each surface sediment location (e.g., SSI014) there will be 3 grab samples collected that will then be composited into 1 sample and labeled as 1 sample (e.g., SSI014). Considering the large volume of sediment collected by a van Veen grab sampler, it is not clear why 3 grabs must be collected and composited at each sample location when the sample analyses are limited to PFCs and conventional parameters. Even the core samples should have sufficient volume to make compositing unnecessary.

If samples must be composited, then a SOP is needed for how the compositing will be performed in the field to ensure representative compositing of the grab samples. This is very difficult to perform in the field with wet material that may consist of a silty/clayey matrix that will be difficult to composite or homogenize. Simple mixing in bowl with a spoon is not an acceptable method of compositing. Therefore, compositing is not recommended. There should be sufficient volume in 1 grab sample for the PFC analysis, including the QC samples. If additional volume is needed for the conventional analyses, then these analyses can be performed on a separate grab sample. If compositing will occur, then this is a deviation from the Department's FSPM and *Ecological Evaluation Technical Guidance* that requires justification pursuant to N.J.A.C. 7:26C-1.2(a)3. If each separate sample will be homogenized together into 1 sample and the whole volume sent to the laboratory, then this not a true composite sample and is

acceptable, but if subsamples will be removed and placed into separate sample bottles, then this is just subsampling of a larger volume and is also not true compositing.

12. Section 2.10.2: It is not clear why sample collection intervals will not be adjusted based on separate horizons in the cores. Geochemical conditions change at deeper depths in sediment, which can affect contaminant distribution, fate, and transport. An explanation should be provided why sample collection intervals will not be adjusted to account for separate horizons in the sediment cores.

13. Section 2.10.2: Revise to clarify how the depth intervals to be sampled for analysis will be determined when there is less than 100% recovery in a core. These depth intervals (0-6 in., etc. will be shorter the less recovery in a core and will also vary in length in a core due to compression deeper in a core). In addition, it is not clear why the target depth for the cores is 6 feet. Also pertains to Attachment B2.

14. Section 2.10.2: It is not clear why core acceptability is contingent on a relatively undisturbed sediment surface and overlying water not being excessively turbid, nor why at least 80% core recovery was selected for acceptable recovery. The first 2 criteria could be resolved by collection of a surface grab sample, if this is really an issue. Clarification is needed to better define core recovery versus penetration depth. If 80% recovery really means achieving 80% of the planned sampling depth to 6 feet, then this criterion doesn't seem necessary unless the sampling depth of 6 feet is better justified. Considering the relatively recent and short term use of PFCs at the Solvay facility, sampling to just 2 or 3 feet should be sufficient, unless sediment deposition rates over the past few decades can be determined to set a more useful sampling depth based on the DQO for sediment sampling.

15. Section 2.10.2: Two options are presented for removing the sediment core from the plastic liner. Extruding the sediment core is not a good idea as this will further disturb the core and make determination of sample collection intervals more difficult. Cutting the liners lengthwise is the better option.

16. Section 2.10.2: The use of Teflon®-lined lids as stated in the last paragraph conflicts with the prohibition of Teflon®-containing materials as stated in Section 2.6 of the FSP. Revise Section 2.10.2 to state the correct type of lids to be used.

17. Section 2.11.3: It is not clear why an equipment blank, trip blank, or field blank will not be collected for the sediment sampling, as will be done for the aqueous sampling.

18. Sections 2.10.1 and 2.13: All surface sediment remaining after processing should be containerized for proper disposal as will be done for the subsurface sediment.

19. Section 3.1: While the information proposed for inclusion in the field logbook is acceptable, such information should also be provided in the form of ground water sampling logs. The Low-Flow Sampling Data Sheet in the FSPM (or equivalent) should be provided for each monitor well. It is recommended that each page in the field logbook be dated and signed, not just the last page for each day of sampling.

20. Section 3.4: Some clarifications are needed for the sample identifiers. The examples included are not consistent between the first bullet and the second bullet. For the matrix identifier, it is assumed that SD will not be used for sediment as shown in the second bullet, but GR or CR will be used instead as shown

in the first bullet. For the sample numbers following the matrix identifier, will zeros be used as shown in the second bullet or will zeros not be used as shown in the first bullet? Finally, the examples provided for the blank samples do not seem consistent with what are provided for the field samples and should be linked in the identifier to the location where they are prepared.

21. Section 4: It is assumed that Tables B-3 through B-5 and other forms mentioned in the FSP are field forms, so the use of "if any" in the third line should be deleted.

22. Section 5: The Department's regulations at N.J.A.C. 7:26C and N.J.A.C. 7:26E should be included as references along with all guidance documents applicable to the proposed sampling, such as the FSPM, ground water investigation, and ecological evaluation guidance documents.

23. Figure B-1: Schedule. Please update the field sampling and reporting schedule as appropriate.